11-1989

ORDINATION AND MAPPING OF WETLAND COMMUNITIES IN NEBRASKA'S RAINWATER BASIN REGION

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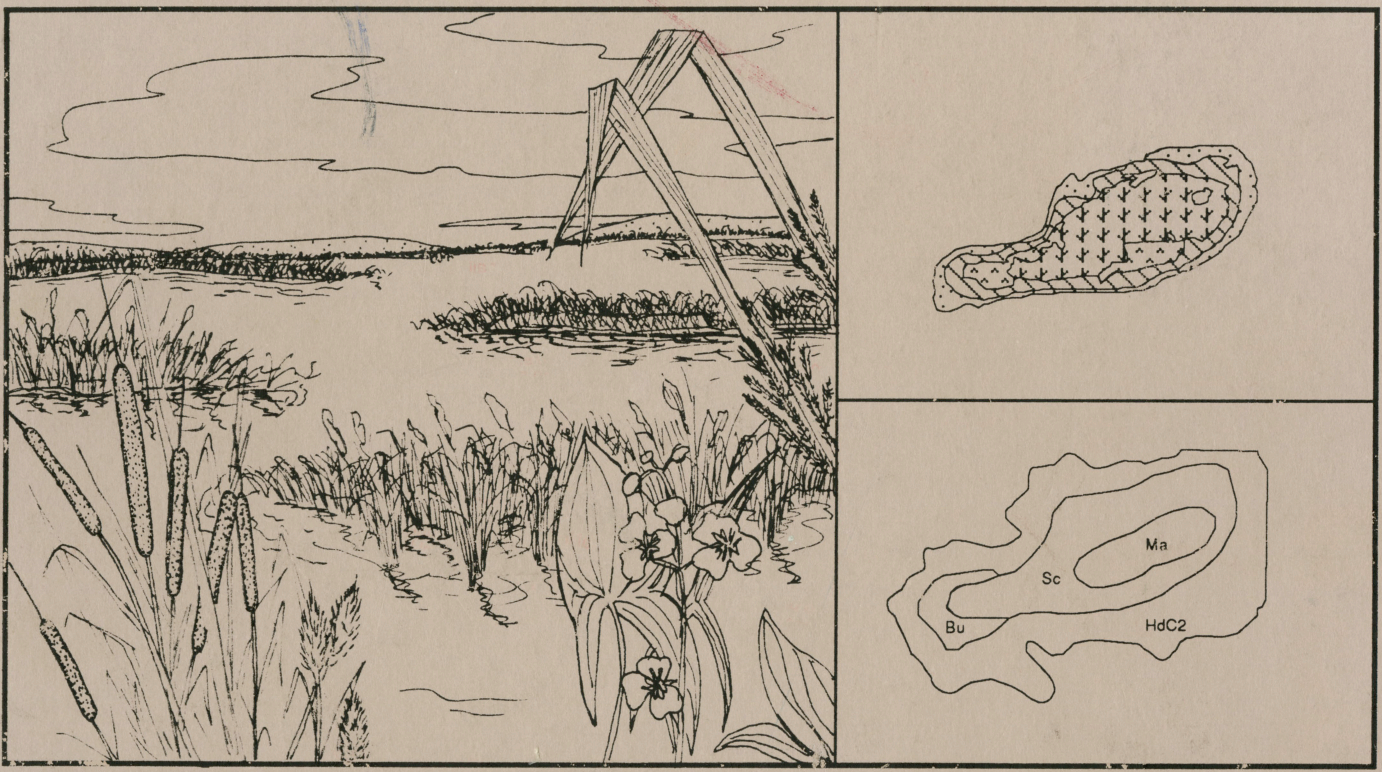

by
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in cooperation with:

U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
Nebraska Game and Parks Commission

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November 1989

Suggested Citation: Gilbert, M.C. 1989. Ordination and mapping of wetland communities in Nebraska's Rainwater Basin Region. CEMRO Environmental Report 89-1. Omaha District, U.S. Army Corps of Engineers, Omaha, Nebraska. 105 pp.

SUMMARY

Forty-seven Rainwater Basin wetlands of south-central Nebraska were evaluated to provide information on vegetation composition, species assemblages determined from direct and indirect ordination methodology, and community characteristics derived from wetlands mapping. Vegetation/soil relationships were evaluated from both vegetational stand and mapping data. Seasonal and year to year vegetation dynamics were evaluated for one study site, Harvard Marsh.

Ordination of vegetational data was accomplished by use of weighted averaging and detrended correspondence analysis. Weighted average ordination results indicated wetland status for the Fillmore, Scott and Massie soil series. Occurrence of upland vegetation on hydric soils and wetland vegetation on non-hydric soils was noted for selected soil series. Overall vegetation/soil correlations were low to moderate. Descriptions and discussion of Rainwater Basin vegetation associations derived from direct and indirect ordinations are presented to document sample and species relationships along the moisture gradient. Temporal ordination at Harvard Marsh indicated changes in stand wetness and species composition for average and wet year comparisons.

Mapping data indicated a highly modified environment based upon the large number of wetland attributes describing hydrologic

alterations, the calculated Correspondence Index, a large percentage of non-wetland on hydric soils, and occurrence of wetland attributes on non-hydric soils.

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ACKNOWLEDGEMENTS

Principal funding for this project was provided by the Omaha District, U.S. Army Corps of Engineers and Region VII, U.S. Environmental Protection Agency. Additional funding in the form of personnel support was provided by the Nebraska Game and Parks Commission and the U.S. Fish and Wildlife Service, Grand Island, Nebraska.

Numerous individuals contributed to this report. The efforts of Mike Rabbe, Dennis Blinkhorn, Dick Gersib, Tom Hupf and Ken Dinan in field data collections are greatly appreciated. A special thanks to Dr. Paul Currier for field assistance and discussions on ordination. Wetlands mapping and data analyses were conducted in cooperation with the University of Nebraska at Omaha's Remote Sensing Applications Laboratory. Mark Laustrup served as project manager and principal investigator for mapping studies. Computer and technical support were provided by Lori Walter, Andy Dinville and Dr. Jeff Peake. The proficiency and dedication displayed by M. Wayne Freel in vegetational data collection and analyses were critical to the completion of this report and forthcoming studies on temporal dynamics. His efforts are particularly appreciated. Dr. David Sutherland's expertise in plant specimen identification and verification is gratefully acknowledged.

The review comments and suggestions of Dr. Michael Scott, Dr. Thomas Bragg and Dr. Don Becker as well as the interagency work team have added greatly to the content of this report. Editorial assistance was provided by Lani Haynes throughout the preparation of this manuscript. A sincere thank you for your patience and professionalism during numerous revisions.

Inspiration and motivation were provided by MF, JGY, RAG, CRE, and F^3 throughout this project. My sincere appreciation and thanks.

INTRODUCTION

The Rainwater Basin area of south-central Nebraska (Figure 1) encompasses approximately 4200 square miles within the Loess Plains region (Condra 1939). Situated primarily on silt loam and silty clay loam soils, the wetlands are found in basin-like depressions where leaching has occurred and deposited an impervious layer of clay beneath the surface. Water, supplied almost entirely by rainfall, is retained in these basins. Infiltration to the lower soil horizons is impeded by a claypan layer. Primary water loss is through evapotranspiration under natural conditions. Surficial hydrology and water budgets have been modified through drainage practices and irrigation return flows into the wetlands (Haberman 1984). Precipitation increases on a general west to east cline within the region with average annual precipitation ranging from 17 inches in Gosper County to 29 inches in Butler County. Variability in precipitation during the growing season and between-years is common.

Origins of the depressional areas within this region are not definitively known and may date back to a time preceding the deposition of Peorian loess (Weaver and Bruner 1954). In their study of the geology and groundwater of Clay County, Keech and

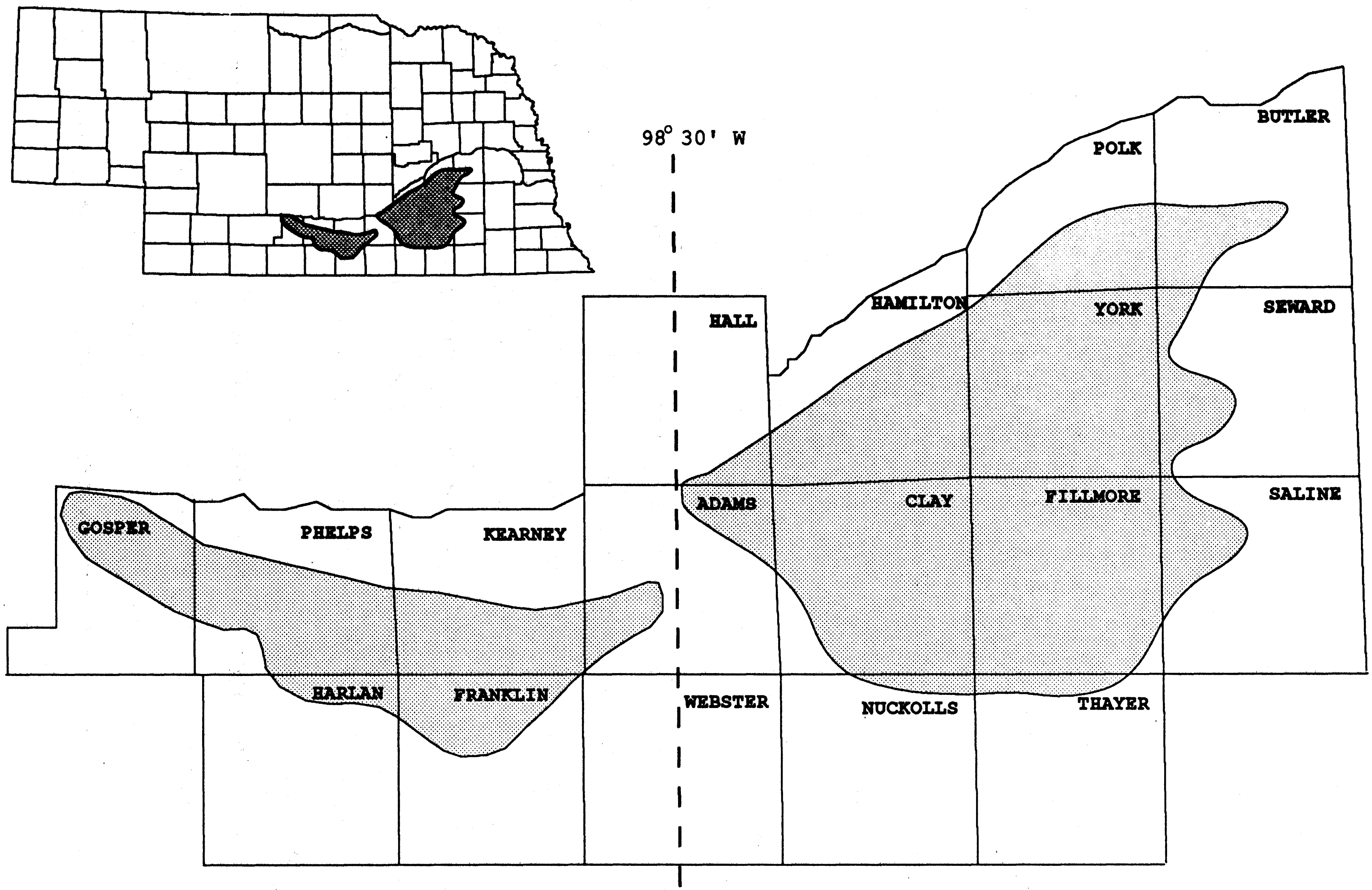


Figure 1. Nebraska's Rainwater Basin wetland region (Adapted from Nebraska Game and Parks Commission 1972).

Dreezen (1959) stated that wind scour, principally in Iowan times, was the dominant agent in basin formation. Starks (1984) evaluated depressional characteristics, distribution patterns, and orientation anomalies in Clay County to provide inferences regarding basin formation. He concluded that wind played a major role in forming and modifying depressions. Additionally, breached basins were documented, suggesting some fluvial influences.

Early observations of Rainwater Basin wetlands were provided by geologists investigating regional water resources. Barbour (1903) referred to numerous lakes south of the Platte River in Kearney and Phelps counties. Lugn and Wenzel (1938) considered the "hummocks of loess" and "marshy depressions" as the only notable relief on the upland plain. Variability in size and the ephemeral nature of the wetlands were also noted. Supporting floristic information were not obtained.

Pre-1950 vegetational studies are limited to the works of Clark (1929) in his study of perennial weeds in York County and Fowler's (1941) study of drought induced changes to true prairies of northern Kansas and south-central Nebraska. Later studies by Weaver and Bruner (1954) provided phyto-geographical data to document the transition from true to mixed prairie in Nebraska. The regional ecotone was placed at the 98°30'W longitude (see Figure 1) roughly bisecting the eastern and western Rainwater Basin regions as defined by the Nebraska Game and Parks Commission (1972). These authors discussed the affinity of wetlands vegetation with the depressional claypan areas (Fillmore and Scott soil series). Additionally, vegetation zones were described qualitatively. Species assignments to different zones were based on depth and permanence of water and general habitat characteristics (see Table 1). Drought induced movement of mixed prairie eastward on the regional scale and invasion of upland or mesic grasses into depressional areas were also discussed. Quantitative wetlands phytosociological work is limited to that of Erickson and Leslie (1987). Weighted average ordination stand scores were evaluated relative to depressional soil series for eight study sites in Clay and Fillmore counties. No region-wide quantitative wetland vegetation surveys have been conducted.

Additional descriptive information of botanical interest is contained in previous wetland inventories (U.S. Department of the Interior 1954; Nebraska Game and Parks Commission 1972, 1984); waterfowl production studies (Evans and Wolfe 1965), and wetlands mapping associated with avian cholera studies (Brown et al. 1983). Other remote-sensing/mapping investigations have provided a general perspective on Rainwater Basin wetland communities. Studies by Walter and Buckwalter (1981) were conducted to determine changes in wetlands from 1936 to 1981 for selected U.S. Geological Survey quadrangles in Clay and Fillmore counties. Land use practices influencing wetlands were included as part of their classification scheme. The utility of airborne multi-spectral scanning techniques as a resource management tool was evaluated by Rundquist (1984) for selected areas of the Rainwater Basin.

Table 1. Vegetation zones for Rainwater Basin depressions as adapted from Weaver and Bruner (1954). Nomenclature has been updated to reflect the Great Plains Flora Association (1986). The rank order from wet to dry has been inferred by the author. Vegetation communities outside of depressional borders were historically mixed or true prairie. See the above cited authors for additional information on these communities.

Habitat Description	Associated Species
Water more or less permanently deep	*Scirpus acutus*
Floating stage, persistent in shallow water	*Potamogeton spp., Marsilea vestita, Bacopa rotundifolia, Heteranthera peduncularis, Alisma subcordatum, Typha angustifolia, Scirpus americanus, Eleocharis acicularis*
Shallow water, 18 inches deep in spring, nearly absent in late-summer	*Eleocharis macrostachya*
Emersed water plants	*Polygonum amphibium var. emersum, Sagittaria calycina, Polygonum bicorne, Coreopsis tinctoria*
Outer edge of large depressions, scattered irregularly through shallower depressions	*Echinochloa crusgalli, Hordeum jubatum, Phalaris arundinacea, Ammania coccinea, Ammania auriculata, Cyperus acuminatus, Vernonia fasiculata, Lippia cuneifolia, Gratiola neglecta, Ambrosia tomentosa*
Border of deep depressions, extensive hay meadows	*Agropyron smithii*
Border of depressions and muddy slopes	*Buchloë dactyloides, Bouteloua gracilis*

Although previous inventory efforts were based partly on soils to provide locations and extent of Rainwater Basin wetlands (Nebraska Game and Parks Commission 1972, 1984), detailed soil-vegetation mapping relationships were not evaluated. Starks (1984) stated that the depressional Butler, Fillmore, Scott and Massie soil series were not necessarily reliable indicators of basin size, shape or location. Associated vegetational data were not included in this analysis. Gersib (pers. comm.) suggested that comparisons of wetlands mapping with soils survey data could provide important information for use in planning wetlands enhancement activities. Also, as soils are relatively static when compared to hydrological or vegetational phenomena, they can be used for inferences regarding historic or "long term average conditions" (Cowardin 1982).

The purpose of this investigation is to provide a regional survey of Rainwater Basin wetland communities. Forty-seven sites were mapped and supporting vegetational data collected. Mapped wetland types and vegetational stand data were evaluated relative to soil mapping units and soils series, respectively. Preliminary data on wetland dynamics are also provided. Goals of this investigation are to provide descriptive information on wetland/soil relationships, document species composition and associations, and provide supporting data for regulatory and waterfowl management initiatives in the Rainwater Basin region.

METHODS

STUDY SITE SELECTION AND GENERAL METHODOLOGY

Individual study sites used in this analysis can be found in Table 2. Candidate sites were derived from a random list generated from Nebraska Game and Parks Commission inventory data (1984). Site documentation files incorporating soil surveys, historic aerial photography and standardized field survey forms compiled during historic inventory works were reviewed prior to final study site selection. The 47 sites selected represent approximately 13% of the estimated number remaining. Sites selected also provided a cross-section of eastern and western Rainwater Basin wetlands.

Nine-by-nine inch format black and white 1:24,000 scale aerial photography flown during field surveys served as the primary source of information for wetlands mapping. Agricultural Stabilization and Conservation Service (ASCS) 35mm color aerial slides were used both as supplemental data to black and white photo-interpretations and as the source of mapping for 7 of the 47 sites. Gradsects[1] (Gillison and Brewer 1985) were established for ground vegetation surveys at each mapping site. Species composition and abundance data were collected in June and the late-summer, early-fall of 1986. Sixteen of the sites analyzed in June 1986 had permanent gradsect locations established for investigation of within-year and between-year vegetation dynamics. Temporal analyses for these

[1]Gradient oriented transects

Table 2. Rainwater Basin wetland study sites. County/number designation is from Nebraska Game and Parks Commission Inventory data (1984).

Site[a]	-Legal Description- Sec	Tnshp	Rnge	USGS 7.5 Quadrangle Name(s)	-Time of Vegetation Survey- June 1986	Late Summer/Early Fall 1986
Butler Ø10a*	36	14N	1E	Rising City	X	
Butler Ø18*	21	15N	3E	David City East		X
Clay ØØ2	35,36	8N	8W	Inland	X	
	31	8N	7W			
	1,2	7N	8W			
	6	7N	7W			
Clay ØØ9	15	6N	6W	Edgar NW	X	
Clay Ø11	16	6N	6W	Fairfield	X	
Clay Ø13	15,16	6N	6W	Edgar NW	X	
Clay Ø24	30	6N	6W	Fairfield		X
Clay Ø33	25,26	6N	6W	Edgar NW		X
Clay Ø35	31	6N	5W	Edgar NW		X
	36	6N	6W			
Clay Ø52	7	5N	5W	Edgar NW	X	
Clay Ø53	7	5N	5W	Edgar NW	X	
Clay Ø94	29	6N	5W	Edgar NW	X	
Clay 152	29	7N	6W	Harvard		X
Clay 216	25	6N	6W	Edgar NW	X	
Clay 227	28,33	7N	6W	Harvard		X
Fillmore Ø13	25,26	6N	4W	Shickley	X	
Fillmore Ø19	30,31	6N	4W	Ong	X	
Fillmore Ø22	23	6N	4W	Shickley		X
Fillmore Ø46	32,33	8N	3W	Geneva SW	X	
	4-6	7N	3W			
Fillmore Ø84	10	7N	4W	Sutton	X	
Fillmore Ø86	5	7N	4W	Sutton	X	
Fillmore Ø91	21,22	5N	3W	Shickley		X
Fillmore 112	18	5N	4W	Ong		X
Franklin ØØ1	25,26	3N	15W	Macon	X[b]	
	35,36	3N	15W			
	30,31	3N	14W			

(Continued)

[a]Study sites with an * indicate ASCS 35mm color slides were used for wetlands' photointerpretation. Specific dates of this photography were unavailable and were generally flown between early July and mid-August.

[b]Two gradsects were evaluated at this site.

Table 2. (Concluded)

Site[a]	-Legal Description-			USGS 7.5	-Time of Vegetation Survey-	
	Sec	Tnshp	Rnge	Quadrangle Name(s)	June 1986	Late Summer/Early Fall 1986
Franklin 004	5	3N	15W	Hildreth		X
Gosper 004	14,15	6N	21W	Oxford NW	X	
Gosper 008	19	7N	20W	Bertrand		X
	24	7N	21W			
Gosper 015*	6	8N	23W	Elwood NW	X	
Gosper 017*	35	8N	23W	Elwood SW	X	
Hamilton 009*	33	10N	8W	Giltner	X	
Hamilton 020*	21	10N	8W	Giltner	X	
Kearney 003	16	6N	16W	Axtell E & W		X
Kearney 013	19,30	5N	14W	Minden S		X
Kearney 017	32,33	5N	13W	Upland SE	X	
Kearney 020	27,28	5N	16W	Wilcox		X
				Hildreth		
				Axtell E & W		
Phelps 001	36	5N	17W	Wilcox		X
Phelps 007	23,24	5N	19W	Holdrege W		X
Phelps 021	27,28	7N	20W	Bertrand SE	X	
Phelps 024	15,16	6N	17W	Axtell W	X	
Polk 018*	36	14N	1W	Rising City		X
				Shelby		
York 020	33,34	9N	2W	Fairmont	X	
	3,4	8N	2W			
York 061	1,2	12N	3W	Stromsburg	X	
York 062	10,11	12N	3W	Durant		X
York 066	18	12N	3W	Durant		X
York 069	9,10	12N	3W	Durant		X
York 077	2,11	10N	1W	Utica SW		X
York 103	13,24	10N	1W	Utica SW	X	

wetlands are the focus of forthcoming studies. Data on Harvard Marsh (Clay ØØ2) are presented.

Soils information derived from Soil Conservation Service (SCS) county surveys and field typing provided a "constant" for comparisons with wetlands mapping data and as a convenient category variable for statistical analysis of vegetational stand data. Soil series and soil mapping units encountered during this study can be found in Table 3.

VEGETATION METHODS

For each of the 47 sites studied, sampling locations along gradsects were selected to account for typical stands of the different vegetation types and ecotones separating them. At each location where vegetation was measured, a soil pedon was evaluated and the soil typed to series. Background information on the presence-absence of hydric soil characteristics were also collected (e.g. gleying, mottling, iron concretions). Determination of hydric soil characteristics followed criteria of the SCS (1987).

Some conventions in this report for soil typing should be noted by the reader. Some soil series typed in the field were not listed for a particular county. The series from a regional perspective most appropriately describing the pedon was used. This occurred most notably for the Massie series where this soil was not listed for selected counties.

Three samples-by-species community data matrices were used in this study. Daubenmire (1959) canopy-cover classes were used as the measure of abundance. The cover estimation applied equally to

Table 3. Soil series and soil mapping units encountered in this study.

Soil Name	Family/Higher Taxonomic Class[a]	Soil Mapping Units[b,c]
Butler	Fine, montmorillonitic, mesic Abruptic, Argiaquolls	Bu,2Bu
Crete	Fine, montmorillonitic, mesic Pachic Argiustolls	(Ce,Cy),CeB,Ct
Detroit	Fine, montmorillonitic, mesic Pachic Argiustolls	De
Fillmore	Fine, montmorillonitic, mesic Typic Argialbolls	Fm,Fo
Geary	Fine-silty, mixed, mesic Udic Argiustolls	GeC2
Hall	Fine-silty, mixed, mesic Pachic Argiustolls	Ha
Hastings	Fine, montmorillonitic, mesic Udic Argiustolls	(Hc,Hs),(HcB,HsB), (HcC,HsC), (HdC2,HuC2), (HdD2,HuD2),HsD
Hobbs	Fine-silty, mixed, nonacid, mesic Mollic Ustifluvents	(He,Hv),2Hb
Holder	Fine-silty, mixed, mesic, Udic Argiustolls	Hg
Holdrege	Fine-silty, mixed, mesic, Typic Argiustolls	(Ho,Hh),(HoA,HhB)HoB
Hord	Fine-silty, mixed, mesic, Cumulic Haplustolls	Hd,HxB
Massie	Fine, montmorillonitic, mesic Typic Argialbolls	Ma
Olbut	Fine, montmorillonitic, mesic Abruptic Argiaquolls	Ob
Scott	Fine, montmorillonitic, mesic Typic Argialbolls	Sc,Sd
Uly	Fine-silty, mixed, mesic Typic Haplustolls	UhG

[a]Data from Soil Conservation Service (SCS) Soil Taxonomy and Soil Interpretations Records (SCS-SOI-5)

[b]Other soil mapping units included: w = water, int = intermittent, M = marsh, up = upland. The symbol M for marsh was used in lieu of the Ma abbreviation to distinguish this mapping unit from the Massie soil series. Upland areas were defined as roads, spoil piles etc., and used as a study mapping convention.

[c]Synonymous mapping units are in ( ), soil symbols that are listed as hydric soils for the entire mapping unit are underlined. The reader is referred to state SCS publications for information on hydric soil components within the other mapping units.

all life forms. For June 1986 vegetation samples (abbreviated JUNEVEG) and the Harvard Marsh temporal data set (abbreviated HARVARD), the mean species cover for five $1m^2$ plots were used. For 1986 late-summer and early-fall vegetation samples (abbreviated FALLVEG), class mid-point values were used in calculations as canopy cover was estimated for one $5m^2$ or $10m^2$ plot.

Samples-by-species matrices for each data set are presented in Appendices A-1 to A-3. Respective matrix sizes are JUNEVEG (136x132), FALLVEG (136x136), and HARVARD (36x80). JUNEVEG and FALLVEG matrices were considered survey data sets and consisted of data from 1986 alone. The HARVARD matrix included data from 4 replicates of 9 samples each for June 1986, August 1986, June 1987 and August 1987. These data were used to describe vegetation dynamics.

Vegetation Analysis

Direct Ordination. Weighted average ordination (WAO) was used for the analysis of all data matrices. Terminology for WAO follows that of Gilbert et al. (1980) and Gilbert (1980). The algorithm used in this study is modified from Gauch (1982):

$$HV_j = \frac{\Sigma HR_i C_{ij}}{\Sigma C_{ij}}$$

HV_j = hydric value, weighted average score for stand $_j$
HR_i = hydric rank, indicator status for species $_i$
C_{ij} = cover value for species $_i$ in sample $_j$
ΣC_{ij} = summation of all species' cover in sample $_j$

Species indicator assignments (HR) were based on a scale of

1 to 9. Rankings reflect the author's opinion as to the moisture preference of the plant record as defined by the inferred amplitude of the species frequency distribution along the moisture gradient. Species found in xeric habitats were assigned a rank of 1, while species normally found in standing water assigned a rank of 9. Species with a wide range of moisture gradient affinities or ubiquitous species were considered mesic and assigned a value of 5. Hydric ranks of 3 and 7 were considered dry-mesic and wet-mesic species respectively. Remaining indicator assignments constituted intervals reflecting a species inferred preference to the wet or dry side of one of the 5 main categories. Plant records not identified to species were assigned a rank of 5 unless the genus or location on a transect indicated a definitive moisture preference. Cultivated species, unique to the FALLVEG data set, were assigned a hydric rank of 5.

Indicator assignments for each plant record were based on habitat descriptions from Muenscher (1972), Gleason and Cronquist (1963), and the Great Plains Flora Association (1986). A state wetland plant list was also used in these determinations (Reed 1986) as well as information from Sutherland (1986). Plant records and hydric ranks can be found in Appendix B. Vascular nomenclature follows the Great Plains Flora Association (1986). Non-vascular records are after Conard and Redfearn (1979). Common names have been assigned to some non-vascular records.

The hydric value (HV) is considered to be a quantitative measure of a stand's position on a continuum from xeric (1) to hydric (9) communities. In this study, a HV of greater than 5.0 is considered a wetland stand and values of less than 5.0 are considered upland. A value of 5.0 is considered mesic. Hydric values were grouped by soil series for descriptive statistics of the survey data sets. For the HARVARD data set, HV's provided an indication of the magnitude of change for replicate stands.

Indirect Ordination. Detrended correspondence analysis (DECORANA or DCA), an eigenvector ordination techinque, was used in the analysis of the JUNEVEG and HARVARD data sets (Hill 1979; Hill and Gauch 1980). The FALLVEG data were deleted from this application due to the occurrence of cultivated species within selected samples. DCA was applied to the JUNEVEG data to elucidate additional information on interstand and species relationships along the gradient. As applied to the HARVARD data, DCA sample scores were used as an expression of stand distance over time. The Harvard Marsh temporal data were treated as one coenocline.

MAPPING METHODS

All wetlands mapping utilized the Cowardin et al. (1979) system of classification. Classification acronyms used in the report are summarized in Table 4. Photointerpretation conventions followed guidelines of the National Wetlands Inventory (U.S. Fish and Wildlife Service 1986). Soils mapping data were derived from the appropriate SCS county survey.

The first step in the wetlands interpretation process involved registering the black and white stereo pairs or 35mm color slides to 1:24,000 USGS quadrangles with a stereo zoom transfer scope.

Table 4. Summary of hierarchical wetland classification terms used in this report (from Cowardin et al., 1979). One incidence of the Riverine System did occur (R4SBA) but is not included in this table.

Classification Abbreviations

System	Class	Water Regime	Special Modifier	Brief Description
U				Upland community
P				Palustrine, freshwater
	AB			Aquatic bed
	EM			Emergent
	FO			Forested
	SS			Scrub-shrub
	UB			Unconsolidated bottom
	US			Unconsolidated shore
		A		Temporarily flooded
		C		Seasonally flooded
		F		Semipermanently flooded
			d	Partially drained
			h	Diked/impounded
			x	Excavated

This process involved locating a minimum of three ground control points which could be identified on both the base map and the imagery. Following this registration procedure a sheet of transparent mylar was placed over the quadrangle base map and secured. The control points were subsequently identified on the mylar overlay and the characteristics of the study site then interpreted.

The soils mapping units were traced at a scale of 1:20,000 and photo-reduced to a scale of 1:24,000. After utilizing the above-mentioned control points, the soils data were then registered. Soil mapping units to be included in a data file were evaluated individually for each study site. Soil polygons included were those that intersected wetland mapping attributes and those appropriate for cartographic presentation purposes.

The registration of a wetlands data file to soils is relative to the ground control points. Once the data layers were completed, the polygons describing Cowardin et al. (1979) attributes and the soil mapping units were digitized at 1:24,000 scale.

The x,y coordinate vector files were converted to a raster format. This process involves trigonometrically converting arc segments (vectors) to a grid format. The grid is composed of cells of equal dimension, known as picture elements or pixels. Acreage statistics of wetland and soil attributes were computed from the raster files for each of the 47 study sites. The acreage figures were calculated by dividing the class pixel count by the number of pixels per acre (69.4).

To characterize wetland/soil mapping relationships at each study site, the total wetland area was divided by the total area of hydric soil mapping units.[2] This ratio, termed the

[2]See Table 3 for hydric soil mapping units included in this calculation. For purposes of this study, the Fo mapping unit (drained Fillmore soils) was treated as a hydric soil in Correspondence Index calculations.

Correspondence Index, was calculated directly for 39 of the 47 study sites where the wetland attributes were nested within the soil polygons. For the remaining sites, the Correspondence Index was estimated to the nearest tenth. In these instances, the hydric soil mapping unit(s) of interest extended to a wetland basin that was not a focus of this study.

A Correspondence Index of "1" would indicate that the mapped wetland area is equal to the sum of hydric soil mapping units. For each study site, the Index provided a comparison of the current wetland extent to its potential historical hydrologic condition inferred from soil survey data.

A crosstabulation program was also used to compare the wetland/soil input files on a pixel by pixel basis. The intersection of Cowardin et al. (1979) attributes were compared to soil mapping units in this manner. These data were aggregated for all 47 study sites for additional descriptions on wetland/soil relationships.

RESULTS and DISCUSSION

VEGETATION RESULTS

Vegetation/Soil Relationships

Mean hydric values and associated descriptive statistics grouped by soil series are presented in Table 5. The 95% confidence interval data indicated vegetational wetland status for the Fillmore, Scott and Massie soil series for both survey sets. For the Fillmore soil series, the two survey data sets had non-overlapping confidence intervals. Insufficient data for the Olbut series prevented any observations beyond that of wetland status for the two stands; both samples were from a cultivated area with subordinate species indicating marginal wetland status.

Confidence interval data for the Butler, Hastings and Holdrege series overlapped the 5.0 upland/wetland breakpoint in one or both data sets. For the FALLVEG data set, the Butler soil series mean hydric value would indicate wetland status. The small sample size for each of these series would, however, indicate caution in applying these results on a regional basis.

Though no statistical inter-sample population comparisons were made, qualitatively combining the JUNEVEG and FALLVEG data provided additional insight. The occurrence of wetland stands on non-hydric soils was 13 observations in 59 samples. The Butler soil series accounted for 5 of these observations with the Hastings and Holdrege soil series having 3 each. Detroit and Holder soil series each had one occurrence of this observation.

Table 5. Descriptive statistics for Hydric Value (HV) data as grouped by soils for the JUNEVEG and FALLVEG survey data sets.

SOIL NAME	JUNEVEG						FALLVEG					
	NO. OF STANDS	MEAN	S.D.	C.V	MIN/MAX	95% C.I.	NO. OF STANDS	MEAN	S.D	C.V.	MIN/MAX	95% C.I.
Butler	6	4.82	.57	11.9	4.33/5.83	4.22-5.42	5	5.17	.21	4.1	5.00/5.44	4.91-5.44
Crete	4	4.00	.29	7.4	3.58/4.26	3.53-4.47	1	4.98	..	..	.....	.....
Detroit	2	5.28	..	..	4.96/5.60	.....	1	4.12	..	..	.....	.....
Fillmore	26	5.74	.93	16.2	4.06/7.09	5.36-6.11	56	6.95	1.4	20.4	2.27/9.00	6.57-7.33
Hall	5	4.25	.31	7.2	3.92/4.70	3.87-4.63	..	..	..	..	.....	.....
Hastings	12	4.50	.70	15.6	3.44/6.07	4.05-4.95	7	4.60	.71	15.4	3.29/5.02	3.95-5.26
Hobbs	2	4.80	..	..	4.74/4.85	.....	..	..	..	..	.....	.....
Holder	2	4.47	..	..	3.91/5.03	.....	2	5.00	..	..	5.00/5.00	.....
Holdrege	5	4.23	.83	19.7	3.29/5.22	3.20-5.27	4	4.52	.92	20.4	3.40/5.47	3.05-5.99
Hord	..	..	..	..	.....	.....	1	4.22	..	..	.....	.....
Massie	34	7.35	.93	12.7	5.42/8.87	7.03-7.68	15	7.56	1.2	15.5	5.41/8.95	6.91-8.21
Olbut	..	..	..	..	.....	.....	2	5.83	..	..	5.75/5.90	.....
Scott	38	6.39	.95	14.9	4.47/8.51	6.07-6.70	42	6.90	1.2	17.3	4.02/8.93	6.53-7.28
	n=136						n=136					

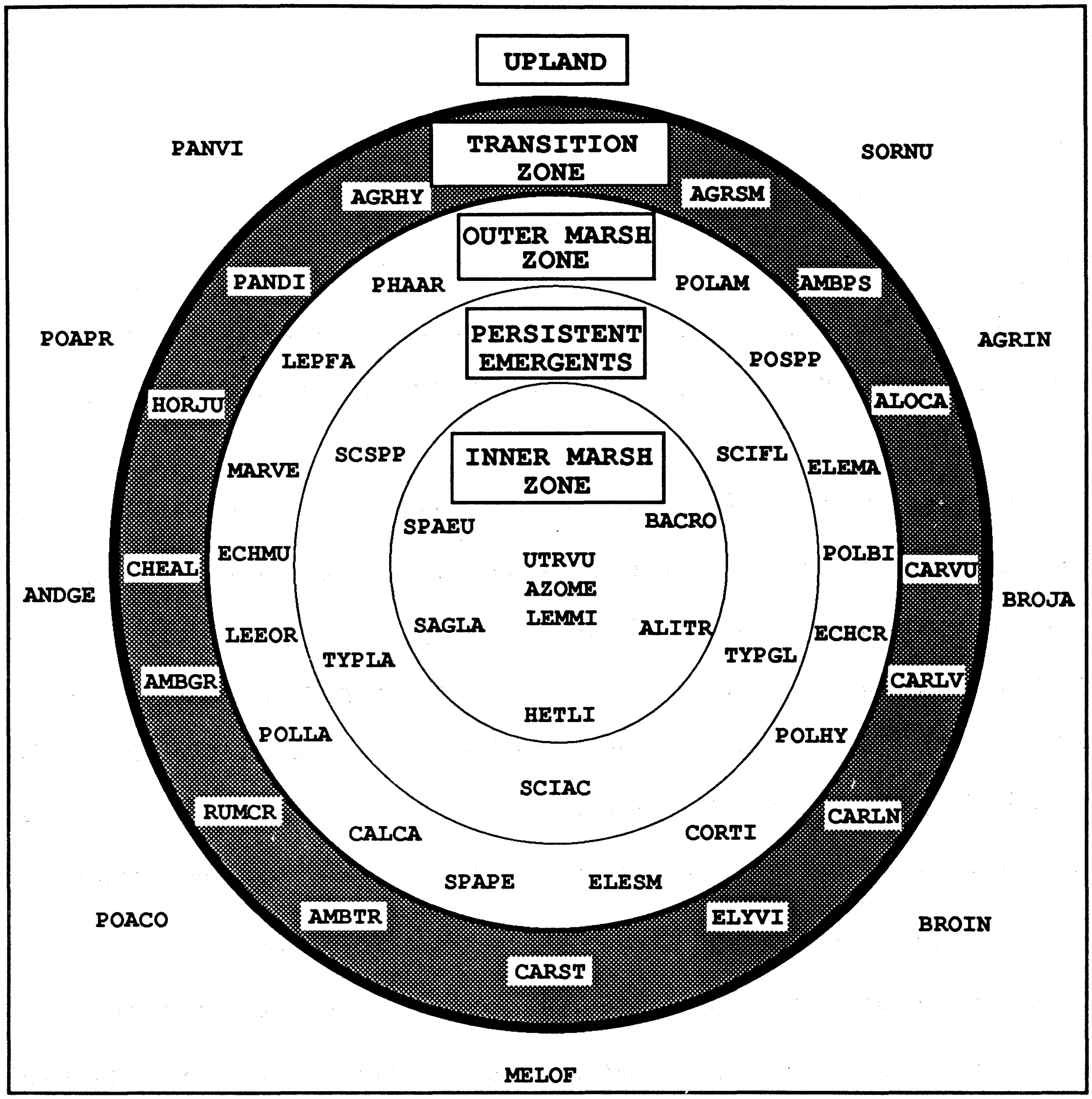
Conversely, upland stand designation for hydric soil series was 17 observations in 213 samples. The majority of these observations were for the Fillmore soil series where upland stands occurred in 12 of 82 samples. The remainder were for Scott soil series where 5 upland stands occurred in the 80 samples.

Overall hydric value/soil series correlations indicated a moderate value for the JUNEVEG data ($r=.53, p>.001$) and a low insignificant correlation for the FALLVEG data ($r=.13, p<.1$).

Direct Ordination

Vegetational stands, as grouped by hydric values and generalized growth form, are presented in Figure 2. Five major zones are presented; an upland zone incorporating both pasture and planted prairie stands, the transition zone including mesic and wet-mesic stands of grass, sedge, and forb growth forms, the outer marsh zone comprised of spikerush and hydrophytic grasses and forbs, the persistent emergent zone, and the inner marsh zone incorporating drawdown and aquatic bed species. Groupings are not necessarily natural associations, but are presented to order the stands in terms of the moisture gradient as determined from weighted averaging. Data from the JUNEVEG and FALLVEG survey data sets have been combined for graphical and narrative purposes.

Composition of upland pasture stands consists of *Bromus inermis*, *B. japonicus*, and *Melilotus officinalis* as common stand dominants. *Agropyron intermedium*, *Poa pratensis* and *P. compressa* were other species occurring as dominants. *Agropyron smithii* dominated stands would be included in the



Agropyron intermedium(AGRIN)
Agropyron smithii(AGRSM)
Agrostis hyemalis(AGRHY)
Alisma triviale(ALITR)
Alopecurus carolinianus(ALOCA)
Ambrosia grayi(AMBGR)
Ambrosia psilostachya(AMBPS)
Ambrosia trifida(AMBTR)
Andropogon gerardii(ANDGE)
Azolla mexicana(AZOME)
Bacopa rotundifolia(BACRO)
Bromus inermis(BROIN)
Bromus japonicus(BROJA)
Calamagrostis canadensis(CALCA)
Carex laeviconica(CARLV)
Carex lanuginosa(CARLN)
Carex stipata(CARST)
Carex vulpinoidea(CARVU)
Chenopodium album(CHEAL)
Coreopsis tinctoria(CORTI)
Echinochloa crusgalli(ECHCR)
Echinochloa muricata(ECHMU)
Eleocharis macrostachya(ELEMA)
Eleocharis smallii(ELESM)
Elymus virginicus(ELYVI)
Heteranthera limosa(HETLI)
Hordeum jubatum(HORJU)
Leersia oryzoides(LEEOR)
Lemna minor(Lemmi)
Leptochloa fascicularis(LEPFA)
Marsilea vestita(MARVE)
Melilotus officinalis(MELOF)
Panicum dichotomiflorum(PANDI)
Panicum virgatum(PANVI)
Phalaris arundinacea(PHAAR)
Poa compressa(POACO)
Poa pratensis(POAPR)
Polygonum amphibium(POLAM)
Polygonum bicorne(POLBI)
Polygonum hydropiper(POLHY)
Polygonum lapathifolium(POLLA)
Polygonum spp.(POSPP)
Rumex crispus(RUMCR)
Sagittaria latifolia(SAGLA)
Scirpus acutus(SCIAC)
Scirpus fluviatilis(SCIFL)
Scirpus spp.(SCSPP)
Sorghastrum nutans(SORNU)
Sparganium eurycarpum(SPAEU)
Spartina pectinata(SPAPE)
Typha glauca(TYPGL)
Typha latifolia(TYPLA)
Utricularia vulgaris(UTRVU)

FIGURE 2. Generalized Rainwater Basin vegetational zones. Species acronyms are stand dominants with groupings based on hydric value intervals for the combined JUNEVEG and FALLVEG data sets.

upland pasture grouping when associated with the above species or ubiquitous, dry-mesic species. Common forbs occurring within the upland pasture included *Solidago rigida, Verbena stricta, Medicago sativa, Aster ericoides, Achillea millefolium, Trifolium pratense, T. repens, Melilotus alba, Lotus purshianus, Taraxacum officinale,* and *Tragopogon dubious*. Pasture stands ranged from dry-mesic to mesic status along the gradient and occurred on the Butler, Crete, Detroit, Fillmore, Hastings, Hall, Holdrege, and Hord soil series.

Andropogon gerardii, Sorghastrum nutans and *Panicum virgatum* were the leading stand dominants in the upland planted prairie type. The majority of these stands were planted for nesting cover on federal or state wildlife management areas. The planted prairie does include pasture grasses in association with these principal species. *Bromus spp.* and *Poa pratensis* commonly occurred with the tall grass species. Other species included *Andropogon scoparius, Rosa arkansana, Ambrosia psilostachya, Asclepias syriaca, Erigeron strigosus, Aster ericoides, Conyza canadensis, Juncus interior* and *Cirsium spp*. Stand scores ranged from dry-mesic to wet-mesic status. The planted prairie type occurred on the Butler, Fillmore, Hastings, Hord, and Scott soil series.

The transition zone stands include ubiquitous forbs, graminoid species and wet-mesic forbs. *Alopecurus carolinianus, A. pratensis, Agropyron smithii, Hordeum jubatum, Agrostis hyemalis* and *Elymus virginicus* occurred as stand dominants. Often associated with these grass species or occurring as stand dominants were *Carex brevior, C. laeviconica, C. stipata,* and *C. vulpinoidea*.

Ubiquitous species in the transition zone included *Ambrosia spp., Chenopodium album, Rumex crispus* and *R. altissimus, Conyza canadensis, Cirsium spp., Apocynum cannabinum*, and *Vernonia fasciculata*. *Ambrosia grayi, A. psilostachya*, and *A. trifida* occurred as stand dominants in outer depressional areas and commonly occurred in other portions of the moisture gradient. Transition zone stands ranged from mesic to wet-mesic and occurred on the Butler, Detroit, Fillmore, Hastings, Hall, Holder, Olbut, Scott and Massie soil series.

In terms of the number of stands, the outer marsh zone would generally be synonymous with smartweed dominated areas. *Polygonum amphibium, P. bicorne, P. lapathifolium, P. persicaria* and *P. hydropiper* were all included in this type. Spikerushes; *Eleocharis macrostachya, E. acicularis* and *E. smallii* were also represented within this portion of the moisture gradient as stand dominants. *Coreopsis tinctoria* and *Marsilea vestita* were included in this grouping, both as stand dominants and associated species. Subordinate species included *Bidens frondosa, B. cernua, Boltonia asteroides, Potentilla norvegica, Aster simplex* and *Rorippa spp*.

Phalaris arundinacea, Leersia oryzoides, Leptochloa fascicularis, Calamagrostis canadensis, Echinochloa muricata and *E. crusgalli* were hydrophytic grass stand dominants of the outer marsh zone. The *Phalaris* stands also occurred in outer depressional areas and often were associated with *Polygonum amphibium* or persistent emergent stands at the wetter end of the gradient. Stand scores ranged from wet-mesic to hydric and occurred on the Fillmore, Scott, and Massie soil series.

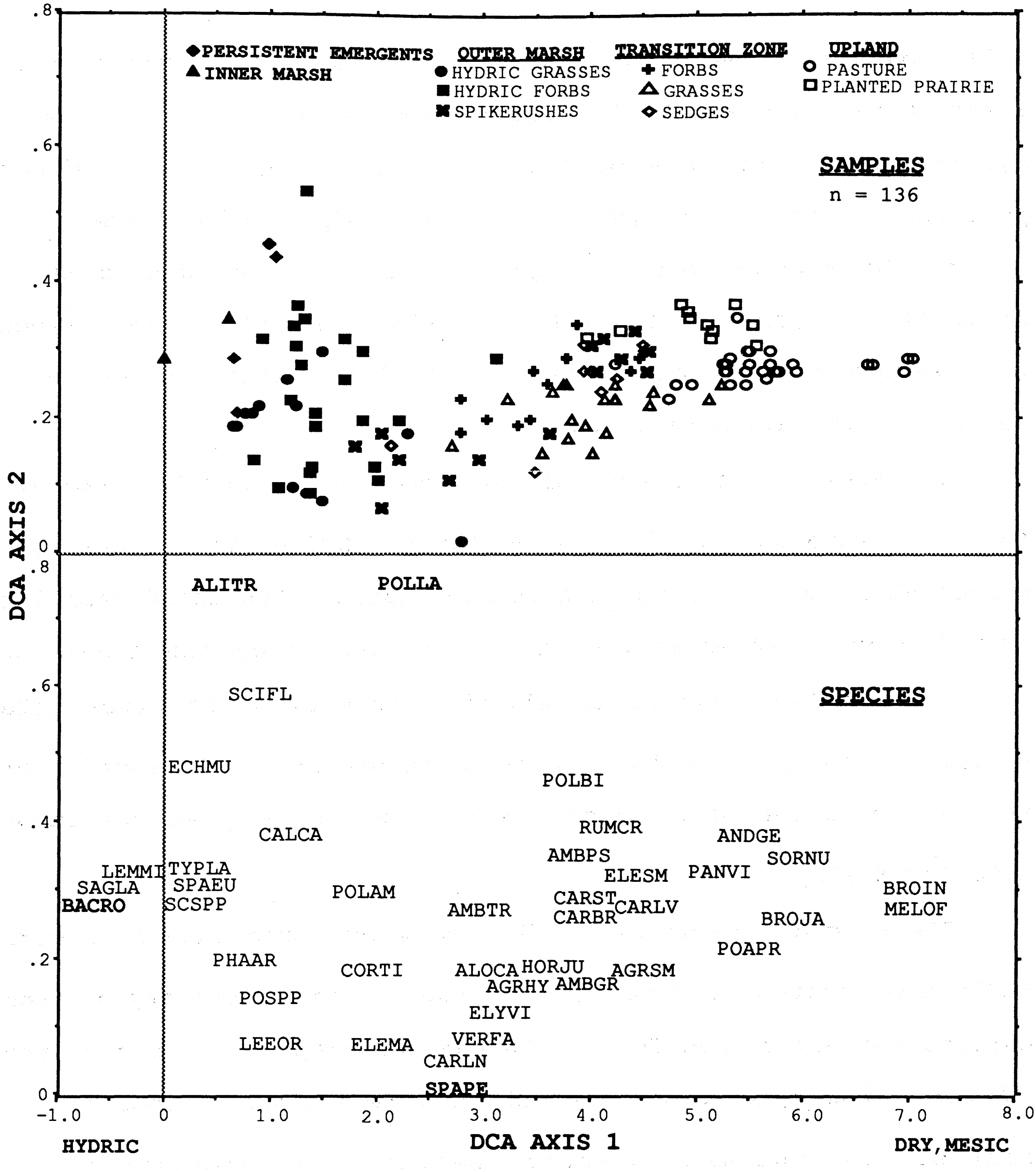
The persistent emergent zone included stands dominated by *Typha latifolia, T. angustifolia, T. glauca, Scirpus spp. (S. acutus* or *S. validus)* and *S. fluviatilis*. These stands were all considered hydric and occurred on the Fillmore, Scott and Massie soil series.

Sagittaria latifolia, S. rigida, Sparganium eurycarpum, Alisma triviale, Bacopa rotundifolia, and *Heteranthera limosa* were the dominant shallow water/drawdown species encountered in the inner marsh zone. Aquatic bed stand dominants for this zone included *Lemna minor, Azolla mexicana,* and *Utricularia vulgaris*. Stands were all considered hydric and occurred on the Fillmore, Scott and Massie soil series.

Indirect Ordination

A composite samples/species DCA ordination for the JUNEVEG data set is provided in Figure 3. The ordination presented illustrates the relationship of samples or species along the moisture gradient according to the zones discussed for the direct ordination results. For the stand data, equal distances in the ordination correspond to equal distances in species composition. A 50% change in stand composition occurs in approximately one standard deviation (Gauch 1982). Species ordinations reflect the amplitude of the species frequency distribution along the gradient (e.g. the center of the species curve; Ter Braak 1987). Plant records used for the species ordination represent stand dominants or commonly occurring species within this data set.

The first ordination axis from left to right is in effect a rank order of samples and species from the inner marsh zone to the



Agropyron smithii (AGRSM)
Agrostis hyemalis (AGRHY)
Alisma triviale (ALITR)
Alopecurus carolinianus (ALOCA)
Ambrosia grayi (AMBGR)
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Andropogon gerardii (ANDGE)
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Bromus inermis (BROIN)
Bromus japonicus (BROJA)
Calamagrostis canadensis (CALCA)
Carex brevior (CARBR)
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Eleocharis smallii (ELESM)
Elymus virginicus (ELYVI)
Hordeum jubatum (HORJU)
Leersia oryzoides (LEEOR)
Lemna minor (LEMMI)
Melilotus officinalis (MELOF)
Panicum virgatum (PANVI)
Phalaris arundinacea (PHAAR)
Poa pratensis (POAPR)
Polygonum amphibium (POLAM)
Polygonum bicorne (POLBI)
Polygonum lapathifolium (POLLA)
Polygonum spp. (POSPP)
Rumex crispus (RUMCR)
Sagittaria latifolia (SAGLA)
Scirpus fluviatilis (SCIFL)
Scirpus spp. (SCSPP)
Sorghastrum nutans (SORNU)
Sparganium eurycarpum (SPAEU)
Spartina pectinata (SPAPE)
Typha latifolia (TYPLA)
Vernonia fasiculata (VERFA)

FIGURE 3. Composite sample/species DCA ordination for JUNEVEG data. Units are in standard deviations. Species outliers are in bold type. (Author's note: for sample scores HV vs DCA1, r = -.91, p>.0001)

upland pasture. The second axis, though providing little overall information, does appear to provide some separation of the more hydrophytic components of the gradient. Separation of the persistent emergent and inner marsh along the "Y" axes are noted and may be attributable to high species dominance within these zones (low compositional similarity between stands). The effect of drawdown species and a more variable environment may also contribute to this separation.

The disjunct occurrence of *Polygonum lapathifolium* and *Spartina pectinata* for both stand and species scores for the hydrophytic grass/forb component of the outer marsh zone may indicate truncated sampling or behavioral differences of these species along the gradient. *Polygonum lapathifolium* occurred as almost a pure stand at study site Phelps 24 and appeared to perform as an opportunistic invader of the exposed marsh bed. *Spartina pectinata* occurred only at one study site (York 103).

The species ordination of *Polygonum bicorne* would suggest a more indicative status as transitional due to the proximity to the Carices and ubiquitous forbs. Though not graphically shown, the *Polygonum persicaria* species score would indicate a similar transitional status. In contrast to these species, the *Polygonum amphibium* ordination would indicate more of an affinity to the persistent emergent and hydrophytic grass portions of the gradient.

Ordinations within the transition zone indicate a higher similarity among samples and a higher incidence of overlap among species distributions as compared to the distal portions of the gradient. Ubiquitous forbs, various Carices, and transitional grasses are all in close proximity. The ordination of *Eleocharis smallii* would suggest this species affinity to the transition zone as opposed to the outer marsh zone inferred in weighted averaging. Also of interest is the position of the *Agropyron smithii* species ordination as intermediate between *Poa pratensis* (upland pasture) and the wet, transitional Carices and *Hordeum jubatum*. The *Panicum virgatum* species ordination also shows an affinity to the transitional species, more so than the other planted prairie species. Ordinations for the upland pasture species indicates *Bromus inermis* and *Melilotus officinalis* position at the dry end of the gradient for the JUNEVEG data set.

Temporal Dynamics

Stand scores for direct and indirect ordination at Harvard Marsh are presented in Table 6. Hydric values for replicate samples indicates a relative constancy in stand wetness for all June 1986 and August 1986 data. Comparative data for the 1987 growing season, considered to have received above normal precipitation, showed only a constancy in hydric values for the planted prairie stands (samples 1-3). The remainder of the coenocline changed in response to the wetter conditions. Stand data for replicate samples 4-6 would suggest change in the order

Table 6. Harvard Marsh temporal ordination data.

Sample Name[a]	Hydric Value	DCA axis 1	DCA axis 2	Time of Sampling
101ANDGE	4.33	51	226	JUNE86
102PANVI	4.50	49	216	JUNE86
103HORJU	5.30	165	225	JUNE86
104HORJU	5.30	295	231	JUNE86
105AMBGR	5.89	361	195	JUNE86
106AMBGR	5.42	352	192	JUNE86
107CORTI	6.42	509	258	JUNE86
108POLAM	7.29	592	239	JUNE86
109POLAM	7.86	618	298	JUNE86
201ANDGE	4.36	35	219	AUGUST86
202ANDGE	3.80	2	217	AUGUST86
203PANVI	5.25	105	215	AUGUST86
204HORJU	5.43	319	223	AUGUST86
205AMBGR	5.40	373	204	AUGUST86
206AMBPS	5.53	388	196	AUGUST86
207CORTI	6.32	521	186	AUGUST86
208POLAM	7.46	596	199	AUGUST86
209POLHY	7.80	613	272	AUGUST86
301ANDGE	4.45	60	226	JUNE87
302ANDGE	4.43	43	218	JUNE87
303AMBPS	5.50	173	214	JUNE87
304SPIPO	6.91	359	299	JUNE87
305ELEMA	7.12	456	191	JUNE87
306BOLAS	7.62	557	199	JUNE87
307ELEMA	7.57	494	254	JUNE87
308POLAM	8.07	641	226	JUNE87
309POLAM	8.53	622	311	JUNE87
401ANDGE	4.22	11	217	AUGUST87
402ANDGE	3.95	0	217	AUGUST87
403PANVI	5.15	164	209	AUGUST87
404AMBGR	5.76	351	213	AUGUST87
405ELEMA	6.87	433	136	AUGUST87
406AZOME	7.95	592	20	AUGUST87
407AZOME	8.91	728	0	AUGUST87
408AZOME	8.56	696	104	AUGUST87
409LEMMI	8.84	690	385	AUGUST87

[a]Sample name refers to time of sampling, sample number along the gradsect, and dominant species for the stand. (e.g. 101 ANDGE = JUNE86 sampling, sample number 1 along the gradsect, and Andropogon geradii as the dominant species.) See Harvard data matrix in Appendix A-3.

of magnitude from borderline wet, transitional stands in 1986 to wet-mesic conditions in 1987. Replicates 7-9 also shifted between-years, with a change from wet-mesic conditions to more extreme hydric conditions. Hydric value data are presented graphically in Figure 4 with stand dominants labeled for each sample.

Indirect ordination results indicate a relative constancy in stand composition for replicates 1-3, the planted prairie types. More definitive shifts were noted for the remainder of the replicates (Figure 5). Little change for replicate 4 was indicated with the exception of the June 1987 ordinate. *Spirodela polyrrhiza* was present as a short-lived stand dominant in this otherwise transitional area. For the August 1987 sampling data at this location, stand composition approximated the 1986 data with a return to dominance of *Ambrosia grayi*.

Comparative ordinations at sample location 5 indicate a compositional change from a transitional forb stand (*Ambrosia grayii*) in the 1986 growing season to spikerush dominated stands (*Eleocharis macrostachya*) for the 1987 growing season data. Within-year variation for the 1986 data ordinates would indicate little compositional changes as would comparative data for the within-year 1987 replicates. Constant species occurring over all times were limited to the aforementioned stand dominants, *Boltonia asteroides* and *Rumex crispus*. June 1987 data indicated the occurrence of inner marsh floating-leaved species (*Lemna minor, Spirodela polyrrhiza*) which were absent from

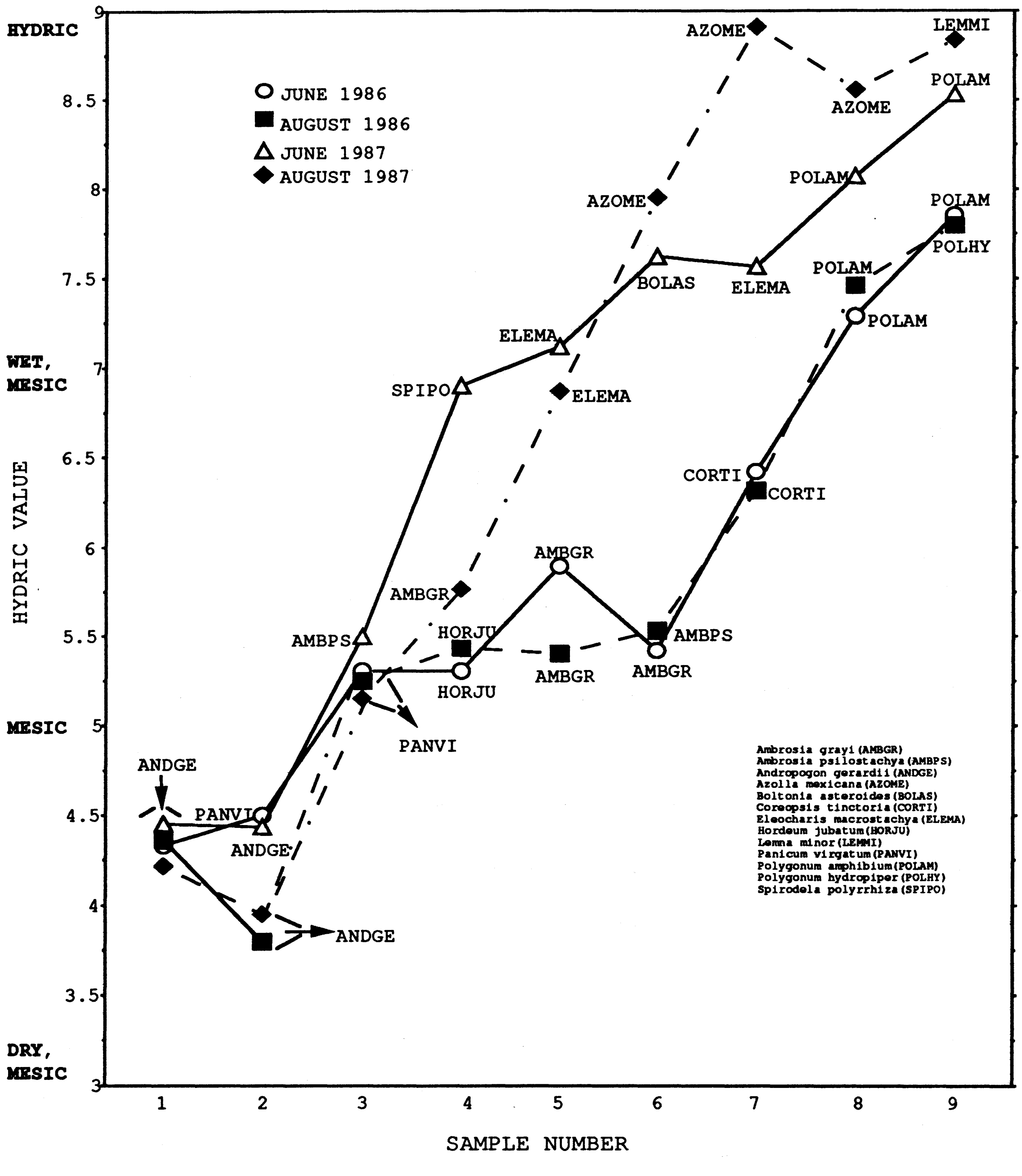


Figure 4. Temporal ordination of hydric value data at Harvard Marsh.

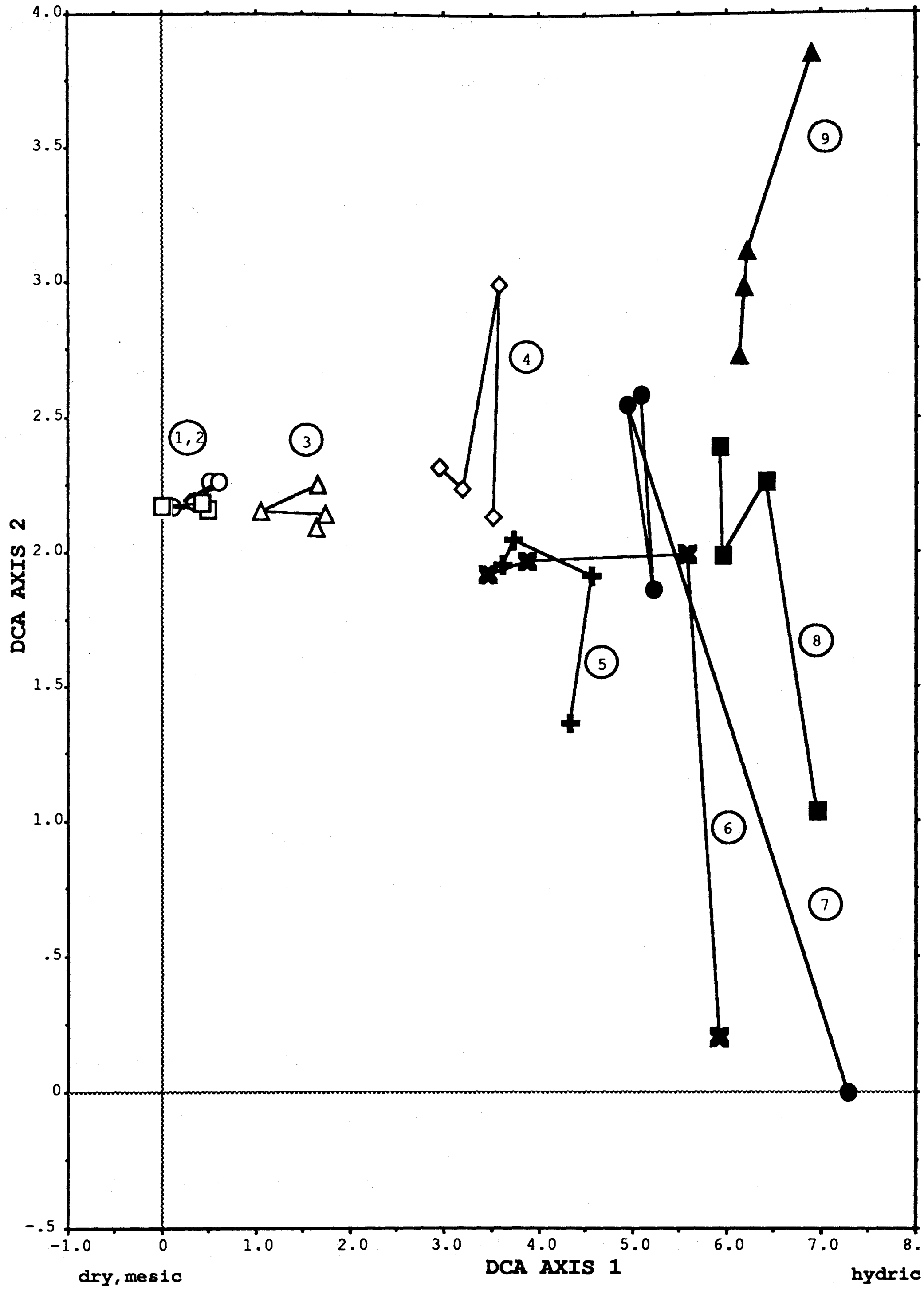


Figure 5. Detrended correspondence analysis stand scores at Harvard Marsh through time. Circles with number insets are the sample locations along the coenocline.See Table 5 for x,y coordinates and corresponding stand dominants.

August 1987 stand data. Drawdown species; *Heteranthera limosa, Sagittaria latifolia*, and *Ammannia coccinea* occurred as subordinate species for August 1987.

Greatest compositional change along the coenocline occurred at replicates 6 and 7 for between-year comparisons. Open water conditions in 1987, low cover values of individual species records, and presence of aquatic bed and drawdown species account for the observed ordination changes. For replicates 8 and 9, relative constancy of 1986 data with June 1987 samples were indicated due to the apparent adaptability of *Polygonum amphibium* to varying moisture conditions. Most notable compositional change for these replicates occurred in August 1987 with the dominance of floating-leaved aquatic bed species.

General observations of species occurrences along the temporal coenocline provided additional insights. Species occurring over all times were represented by the perennial planted prairie species and ubiquitous forbs. Although, changing in abundance and sometimes position along the gradient, constant wet-mesic and hydric species included *Boltonia asteroides, Carex lanuginosa, Coreopsis tinctoria, Eleocharis macrostachya, Hordeum jubatum, Polygonum amphibium, Rumex crispus,* and *Scirpus fluviatilis*. Late-growing season species occurrences (August 1986 and August 1987), both a function of phenology and changing moisture conditions, were represented by *Bacopa rotundifolia, Ammannia coccinea, Polygonum bicorne, P. hydropiper*, and *P. ramosissimum*. Species occurring only under wet-year conditions (June 1987, August 1987) included *Azolla mexicana, Bidens frondosa, Heteranthera limosa, Leersia oryzoides, Lemna minor, Sagittaria latifolia, Spirodela polyrrhiza, Teucrium canadense*, and *Utricularia vulgaris*.

MAPPING RESULTS

Site Descriptive Data

Wetland and soil maps for each of the 47 study sites can be found in Appendix C. A summary of wetland mapping attributes and Correspondence Index results are presented in Table 7. Considering only predominant wetland mapping attributes, 42 sites had a special modifier indicating altered hydrologic conditions. The "d" special modifier, descriptive of a wetland polygon(s) as partly drained, occurred at 40 sites. The remaining special modifiers for predominant wetland attributes consisted of impounded ("h") at York 66 and excavated ("x") at York 77.

The excavated special modifier was used commonly in this investigation due to the presence of artificial water retention structures (irrigation reuse pits, stock ponds). The PUBFx classifier, describing these types of polygons, occurred at 38 study sites. Other photointerpretable features indicating alterations in hydrology, consisted of PEMCx and PEMFx mapping attributes at 20 sites.

For the 5 sites where Cowardin et al. (1979) special modifiers were not associated with predominant wetland mapping attributes, other types of modifications were noted from field observations or the photographic record. Study site Butler 18 was farmed while

Table 7. Summary of mapping characteristics for individual study sites.

Study Site Name	Size (acres)	Number of Wetland Types	Predominant Wetland Type(s)[a]	Correspondence Index[b]	Corresponding Vegetational Data Set
BUTLER10A	24.3	4	PEMFd[41%],PEMCd[35%]	.07	FALLVEG
BUTLER18	3.3	1	PEMA[100%]	.12	FALLVEG
CLAY2	754.7	9	PEMCd[61%]	.89	JUNEVEG
CLAY9	62.9	5	PEMFd[60%]	*.90	JUNEVEG
CLAY11	35.1	5	PEMFd[42%],PEMCd[42%]	.79	JUNEVEG
CLAY13	16.0	3	PEMAd[86%]	*.60	JUNEVEG
CLAY24	35.0	2	PEMCd[79%]	.57	FALLVEG
CLAY33	34.8	3	PUBF[59%]	.89	FALLVEG
CLAY35	77.9	5	PEMCd[49%],PEMFd[35%]	.82	FALLVEG
CLAY52	37.2	3	PEMCd[73%]	.56	JUNEVEG
CLAY53	37.1	3	PEMCd[67%]	.56	JUNEVEG
CLAY94	84.4	4	PUBF[39%],PEMC[26%]	1.31	JUNEVEG
CLAY152	18.3	3	PEMAd[67%]	.27	FALLVEG
CLAY216	8.6	2	PEMC[58%]	1.01	JUNEVEG
CLAY227	21.6	3	PEMAd[93%]	.58	FALLVEG
FILLMORE13	215.1	10	PEMF[29%],PEMC[25%]	*.70	JUNEVEG
FILLMORE19	60.0	4	PEMAd[89%]	.72	JUNEVEG
FILLMORE22	10.2	3	PEMAd[63%]	.39	FALLVEG
FILLMORE46	490.8	5	PEMCd[40%],PEMAd[37%]	.79	JUNEVEG
FILLMORE84	153.1	7	PEMFd[31%],PEMAd[30%]	.67	JUNEVEG
FILLMORE86	65.8	5	PEMCd[53%]	*.40	JUNEVEG
FILLMORE91	117.7	6	PEMCd[52%]	.62	FALLVEG
FILLMORE112	17.3	5	PEMCd[50%],PEMAd[34%]	.28	FALLVEG
FRANKLIN1	611.7	6	PEMAd[64%]	.51	JUNEVEG
FRANKLIN4	55.0	2	PEMCd[95%]	.28	FALLVEG
GOSPER4	37.4	3	PEMAd[87%]	1.05	JUNEVEG
GOSPER8	66.6	6	PEMCd[80%]	.65	FALLVEG
GOSPER15	3.4	2	PEMCd[95%]	.62	JUNEVEG
GOSPER17	15.4	4	PEMAd[58%]	.53	JUNEVEG
HAMILTON9	9.7	2	PEMCd[91%]	.91	JUNEVEG
HAMILTON20	48.1	3	PEMAd[71%]	.77	JUNEVEG
KEARNEY3	89.7	6	PEMFd[71%]	.49	FALLVEG
KEARNEY13	16.1	3	PEMAd[79%]	*.60	FALLVEG
KEARNEY17	43.7	3	PEMCd[70%]	*.90	JUNEVEG
KEARNEY20	109.5	6	PEMFd[46%],PEMCd[38%]	.91	FALLVEG
PHELPS1	20.0	3	PEMCd[51%]	*1.10	FALLVEG
PHELPS7	105.5	4	PEMCd[65%]	.52	FALLVEG
PHELPS21	242.4	7	PEMCd[43%],PEMFd[27%]	.94	JUNEVEG
PHELPS24	158.6	6	PEMCd[49%],PEMFd[38%]	1.10	JUNEVEG
POLK18	10.5	2	PEMCd[99%]	.32	FALLVEG
YORK20	258.9	7	PEMCd[39%],PEMFd[32%]	1.07	JUNEVEG
YORK61	86.1	7	PEMCd[47%],PEMAd[21%]	1.04	JUNEVEG
YORK62	148.5	6	PEMCd[43%],PEMFd[40%]	.81	FALLVEG
YORK66	103.8	6	PUBFh[57%]	.49	FALLVEG
YORK69	47.1	5	PEMCd[69%]	.78	FALLVEG
YORK77	12.6	2	PUBFx[55%]	.30	FALLVEG
YORK103	20.3	5	PFOAd[67%]	*.40	JUNEVEG

[a]Predominant wetland types are the sum of the mapping attributes accounting for greater than 50% of the study sites' area.

[b]Study sites where the Correspondence Index were estimated are indicated by an *.

Clay 216 had evidence of haying. Both Clay 33 and Fillmore 13 were divided by a county road. For the latter site, the partly drained special modifier applied only to polygons on the east side of the road. The majority of this basin was, however, classified with no special modifiers. Clay 94, a federal waterfowl management area, receives water from pumping during waterfowl migration and excess irrigation water from agricultural lands north of the basin.

Correspondence Index values ranged from .07 at Butler 10a to 1.31 at Clay 94. Mean value for all study sites was .67. The study sites included within the FALLVEG survey data set have lower Correspondence Index values as compared to those of JUNEVEG data (FALLVEG $\overline{x}$ = .54, JUNEVEG $\overline{x}$ = .79).

Seven study sites have a Correspondence Index exceeding 1.0, indicating that the areas of mapped wetland attributes were greater than that of hydric soils. For study sites Clay 94, Phelps 1, and York 20; relatively steep topography within the localized subwatershed and lack of natural or artificial outflow conveyance features may help explain the Correspondence Index at these sites. Artificial inflows may also contribute to this phenomena. Phelps 24 is located in a groundwater mounding area attributed to recharge from irrigation distribution systems (Ellis and Wigley 1987).

No inferences are provided for the remainder of the sites (Clay 216, Gosper 4, and York 61) as the available data did not provide sufficient evidence for these types of generalizations. The degree of exceedence above the 1.0 ratio is small for each of these sites and may be attributable to limitations in the registration or digitization processes.

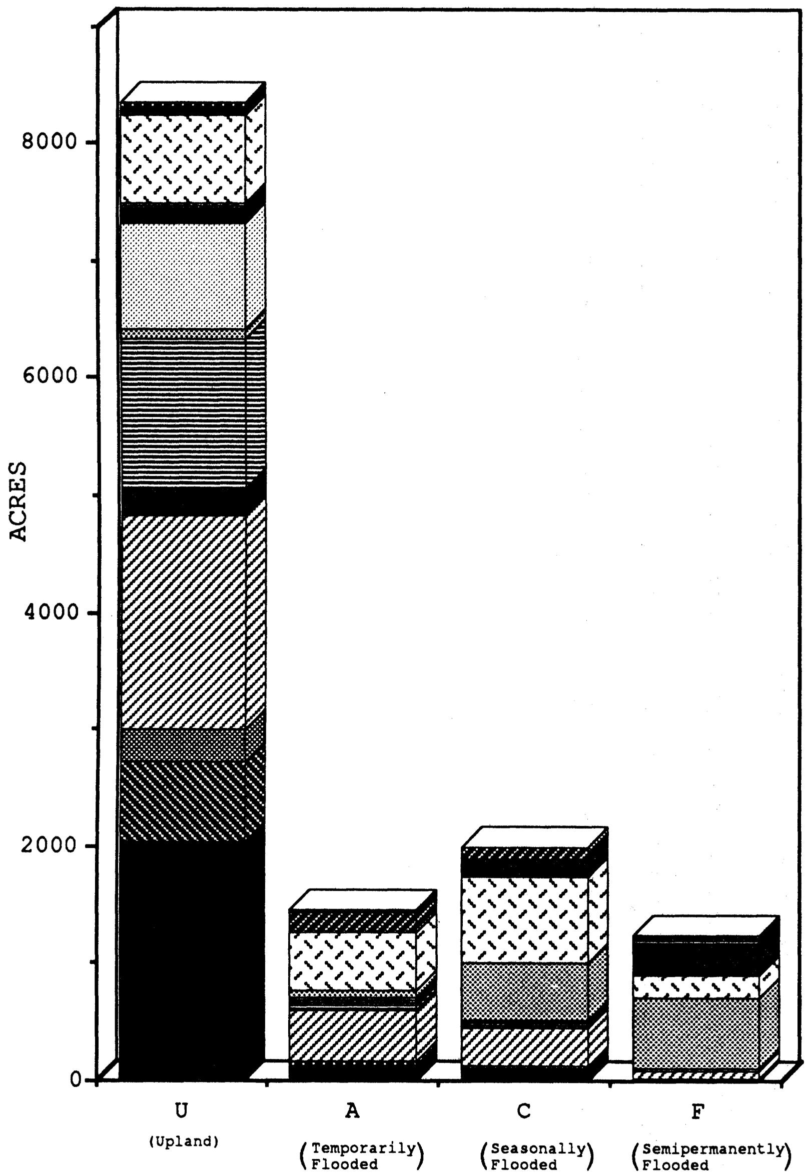
Aggregated Data

Crosstabulation results for Cowardin et al. (1979) wetland attributes versus soil mapping units for all study sites can be found in Appendix D. Soil attributes have been grouped to series and selected soil mapping units for narrative and graphical purposes.

The total wetland acreage mapped in this study was approximately 4,696 acres. Percent composition by wetland attributes was 39% for PEMCd, 26% for PEMAd, and 15% for PEMFd. The remaining 20% was divided among 18 Cowardin et al. (1979) types with no wetland attribute accounting for more than 3% of the total acreage.

The soils data base was represented by 13,035 acres encompassing 33 soil mapping units. Composition by selected soil series was 20% for Fillmore soils, 18% for Butler soils, 17% for Scott soils, 10% for Hastings soils, and 9% for Massie soils. Ten other soil series and 4 mapping units (marsh, intermittent, water and upland) accounted for the remaining 24%.

A summary of crosstabulation data for wetlands grouped by upland and the temporarily, seasonally, and semipermanently flooded water regimes versus selected soil series/mapping units is presented in Figure 6. Mapped wetland types were found in all soils listed in this Figure with the exception of the Geary series. Hydric soil inclusions within non-hydric soil units or resolution limitations inherent in digitization may account for these



Soil Unit	Acres of soil unit	Acres of soil unit intersecting upland and water regimes			
		U	A	C	F
Butler	2303.8	2030.3	136.3	111.7	25.5
Crete	730.2	691.8	30.4	6.0	2.0
Detroit	295.0	280.7	5.7	7.6	1.0
Fillmore	2641.0	1824.0	433.7	316.7	66.6
Hall	246.4	242.2	1.8	2.1	0.3
Hastings	1325.4	1270.6	39.6	13.7	1.5
Hobbs	135.4	82.7	28.1	15.9	8.7
Holdrege	952.1	900.9	23.8	20.8	6.6
Hord	124.2	109.0	3.9	10.6	0.7
Massie	1183.7	36.5	58.5	493.3	595.4
Olbut	26.8	24.4	2.4	0.0	0.0
Scott	2185.9	753.7	493.1	749.3	189.8
Marsh	458.7	24.1	9.3	137.1	288.2
Water	19.4	4.6	1.9	5.9	7.0
Int	342.7	43.5	168.5	94.6	36.1
Other					
Geary	0.8	0.8	0.0	0.0	0.0
Holder	3.5	2.7	0.6	0.2	0.0
Uly-Hobbs	21.5	17.5	3.7	0.0	0.3
Upland	37.9	0.0	16.4	14.0	7.5

Figure 6. Crosstabulation results of selected soil units versus upland and Cowardin et al. (1979) water regimes.

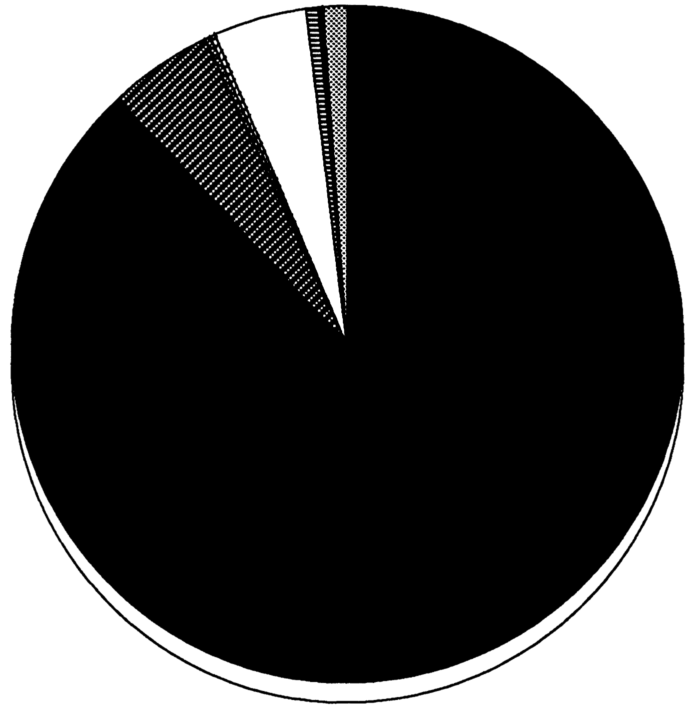
occurrences.

Figure 7 provides the percent composition of Cowardin et al. (1979) wetland attributes for selected depressional soil series. For the Butler soil series, 12% of the acreage was mapped as wetland. Predominant wetland attributes were the PEMAd and PEMCd classes. The Fillmore soil series had approximately 69% of its area considered non-wetland. Of the wetland attributes mapped, PEMAd and PEMCd were the predominant classes at 14% and 11% respectively. Scott soils also had a large percentage of non-wetland. Thirty-four percent of this soil series was considered upland. PEMCd was the predominant wetland class at 32% followed by PEMAd at 19%. Three percent of the Massie soils was non-wetland. PEMCd and PEMFd were the predominant wetland classes at 39% and 29% respectively.

Although not presented graphically, the soil mapping units marsh, intermittent, and water all have high percentages of wetland attributes. Ninety-five percent of the marsh mapping unit and 87% of the intermittent mapping unit were mapped as wetland. The soil mapping unit designated as water had 76% of its area considered wetland, largely intersecting PUBFx wetland attributes.

Butler Soil Series

(n= 2303.8 ac.)



Wetland type	Soil Series Butler (%)	Fillmore (%)
U	88	69
PEMAd	5	14
PEMA	tr	tr
PSSAd	tr	2
PEMCd	5	11
PEMC	tr	tr
PEMFd	tr	tr
PEMF	tr	0
PUBFd	0	tr
PUBF	tr	0
PUBFx	tr	2
Other	tr	1

Fillmore Soil Series

(n= 2641.0 ac.)

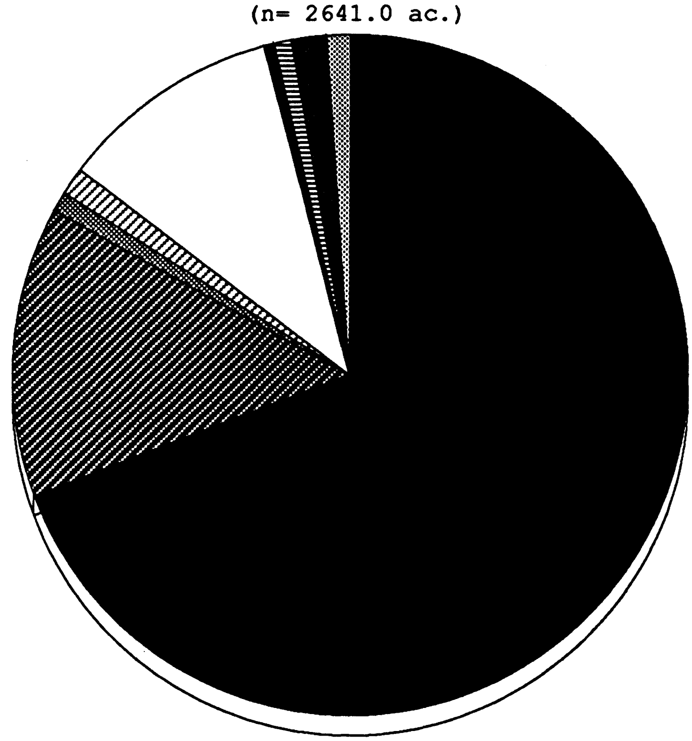
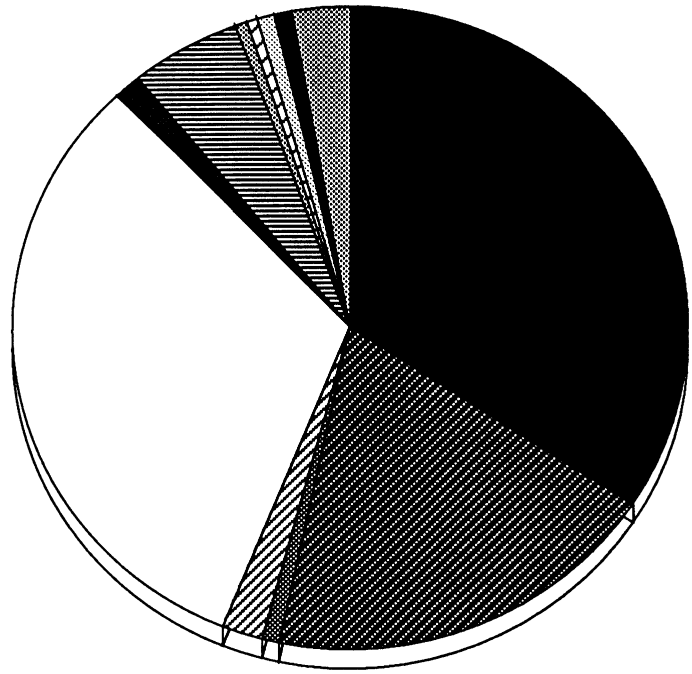


Figure 7. Intersection of selected Cowardin et al.(1979) attributes with depressional soil series. Data presented are in percentages, trace (tr) is < 1.0%.

Scott Soil Series
(n= 2185.9 ac.)



Wetland type	Soil Series Scott (%)	Massie (%)
U	34	3
PEMAd	19	4
PEMA	tr	tr
PSSAd	2	tr
PEMCd	32	39
PEMC	1	3
PEMFd	5	29
PEMF	tr	6
PUBFd	tr	10
PUBF	tr	4
PUBFx	tr	1
Other	2	tr

Massie Soil Series
(n= 1183.7 ac.)

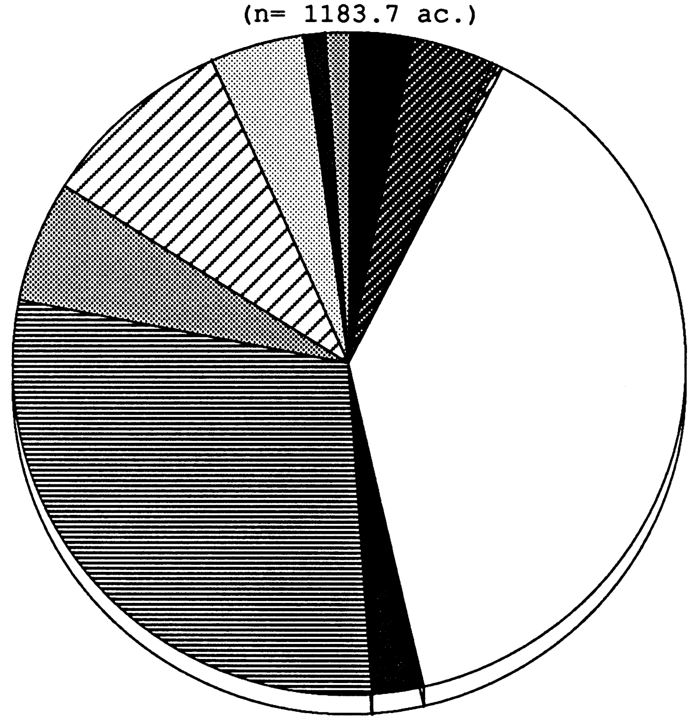


Figure 7. (Concluded)

CONCLUSIONS/RECOMMENDATIONS

CONCLUSIONS

This study provided information on Rainwater Basin wetlands' vegetation composition, species assemblages determined from direct and indirect ordination methodology, and community characteristics derived from wetlands mapping. Vegetation/soil relationships were evaluated from both vegetational stand and mapping data. Vegetation dynamics were evaluated for one study site, Harvard Marsh.

Although no specific attempt has been made to integrate vegetational survey data with mapping data, some inferences can be drawn. Gauch (1982) stated that environmental interpretation of ordination results must rest on data and insights external from the ordination analysis. Wetlands mapping data allowed this opportunity and provided a more realistic depiction of existing conditions than vegetational data alone.

Mapping data indicates a highly disturbed environment based upon the common occurrence of Cowardin et al. (1979) modifiers describing hydrologic alterations, the calculated Correspondence Index, the large percentage of uplands on hydric soils, and the occurrence of wetland attributes on non-hydric soils. Additionally, although weighted average ordination results indicated wetland status for Fillmore, Scott and Massie soils; the large percentage of uplands associated with the former two series determined from mapping data would indicate caution in generalizing vegetation/soil relationships in Rainwater Basin wetlands.

Factors influencing species composition and distribution in northern prairie wetlands include hydrologic regime, salinity of water, the edaphic complex, plant competition, pH, nutrient status and the seed bank (Dix and Smeins 1967, Walker and Coupland 1968, Dirshl and Coupland 1972, Stewart and Kantrud 1972, Millar 1973, and van der Valk and Davis 1978). Walker and Wehrhahn (1971) stated that disturbance is the major environmental gradient affecting species distributions. Cultivation was considered as the most drastic type of disturbance by Walker and Coupland (1968) and considered to "override" the effects of other natural gradients. Dix and Smeins (1967) also addressed cultivation and observed an irregularity in stand ordinations for cultivated depressions.

All of the above factors may be influencing Rainwater Basin plant communities. For the majority of these wetlands, alterations of the hydrologic regime through drainage and land use practices are probably the principal factors determining floristic composition.

Another factor responsible for determining species composition is the fluctuation of water, both within-year and between-years (Walker and Coupland 1968). Vegetation dynamics documented at Harvard Marsh for average and wet-year comparisons indicated an approximate change in stand wetness from mesic to extreme hydric conditions. Within-year and between-year changes in species composition were also noted, as were shifts in abundance of species along the coenocline.

Smeins (1967) cautioned about making judgements regarding vegetation of the "current" water regime because previous water regimes and land uses have lingering effects. Additionally, the broad ecological amplitudes of many wetland species make it difficult to relate vegetation composition to hydrology (Dix and Smeins 1967). These studies, as well as findings from the Harvard Marsh data, would indicate a need for considering temporal variation in any vegetation characterizations of Rainwater Basin wetlands.

RECOMMENDATIONS

Implications of these data to regulatory or resource management needs are many. Refinement of species indicators is recommended, particularly for ubiquitous and drawdown species. Detrended correspondence analysis species scores may provide this opportunity. This methodology ordinates a species amplitude along the moisture gradient and can also be readily tested/evaluated against other environmental gradients. Current indicator assignments in use (Reed 1988) are based upon a species frequency distribution and may not accurately describe the moisture gradient when used in weighted averaging.

The low vegetation/soil correlations and similar vegetation types found across a range of soil series may suggest a higher reliance on vegetation for wetland delineation purposes. A stochastic ordination does not, however, take into account successional changes, vegetation response to disturbance or varying wet-dry cycles. Utilization of temporal remote sensing techniques to document maximum, average, and minimum wetland area as well as changes in wetland mapping attributes within a basin is suggested. Concurrent ordination studies to typify and document changes in vegetation stands associated with Cowardin et al. (1979) wetland types would allow a more accurate assessment of Rainwater Basin wetlands for regulatory or wildlife management interests.

Refinement and further evaluation of the Correspondence Index is needed. This measure, utilized in a descriptive manner for this study's purposes, has broader implications for resource management applications. This Index could be used for inferences regarding a wetlands degree of disturbance, to provide trend information when measured temporally, and as a tool to assist wetland managers in determining a basin's restoration potential.

This study described Rainwater Basin wetlands from a "bottom up" approach; from the species level to vegetation stands, mapping attributes within a wetland, individual wetlands and aggregated mapping data. For future wetlands stewardship, a "top down" perspective is suggested to maximize this study's results and other Rainwater Basin initiatives (Gersib et al. 1989). Geographic information system development to describe, summarize and monitor the Rainwater Basin region's wetlands population is warranted. Incorporation of historic inventory data, National Wetlands Inventory mapping and soils information would allow analyses of extinct/extant wetlands (or complexes) for restoration, enhancement, or determination of priorities for acquisition.

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APPENDIX A

VEGETATION MATRICES

Appendix A-1. JUNEVEG data matrix.

```
(I3,2X,10(I3,1X,F7.2,1X))                                      10
  1   10   52.40 103   29.00  81   14.00  58    7.20  11   10.60  36    1.20 113    7.60  56    0.80 116    0.40
  2   81   61.60  10   14.00  16    9.80  11    3.80 103    3.40 113    3.40  36    0.80  61    0.40  14    0.40
  3   56   35.20  23   28.00  30   27.60  81   23.00   8   11.40  16    6.40   3    6.40  36    3.40  84    3.00  48    3.00
  3  103    0.40  40    0.40   2    0.40  75    0.40  61    0.40  80    0.40  92    0.40
  4   56   85.00   7   52.40 103   17.00   8   23.40  93    0.40  23    0.40   3    0.40
  5    7   85.00   8   35.80  46   23.40 103    9.40  68    2.00   6    4.20  55    1.20   3    7.60  56    0.80 140    0.40
  6    7   75.80  69   66.60   3   43.00   8   37.40  56    4.20  68    1.60 103    1.60  55    1.20   6    3.40 140    0.80
  6   78    0.40  41    0.40
  7   41   66.40  91   44.60  63    7.20 129    4.20 103    6.40  88   12.40  55    3.40 140    0.80  46    0.80  99    0.40
  7    5    0.40
  8   88   71.00  41   28.40  99    4.60  91   20.00  63    1.20 129    0.40  90    0.40
  9   88   75.60 106   57.00  91   40.40  41   13.60  99    4.60  63    1.60   5    0.40  90    0.40 103    0.40
 10   22   85.00 112   38.40 128    3.00  82    0.40  14    0.40
 11   87   85.00  88   17.00  93   11.40  56    6.80  85    1.20   3    3.00  86    0.40  36    0.40  39    0.40  79    0.40
 12   87   85.00  88   11.40  60    0.40 106    0.40
 13  106   80.40  88   61.80  93    0.80  36    0.40  63    0.40
 14   88   85.00 106   34.40 124   15.80   4    6.80  93    1.20 107    1.20  87    3.40  63    0.80   5    0.80  97    0.80
 14   60    3.00 116    0.40  46    0.40 105    0.40  75    0.40  91    0.40
 15   23   61.80  81   29.00  14   21.60 113   21.20  22    3.80  52    1.20  86    1.20  80    1.20  61    0.80   8    0.80
 15   36    0.40  27    0.40  56    0.40
 16  113   57.00  88   52.20  52   26.40  83   14.40  81   20.00  36    7.20   3    6.40  80    1.60  30    8.00  14    3.80
 16   79    3.80   8    1.20  93    3.40  23    3.00  56    0.40  61    0.40   9    0.40 103    0.40
 17   49   85.00   8   80.40  46   44.80   3   42.20  28   32.80  88   24.20  56    1.60 128    9.00  36    1.20  52    0.40
 17   61    0.40 123    0.40  85    0.40
 18    8   87.60  46   66.60   3   54.60 128   43.00  88   33.40   7   18.60  12    8.40  56    3.80   6    0.80  28    3.00
 18   36    0.40  80    0.40
 19   46   80.40  87   66.40 140   52.40  88   47.20  41    2.00   3    4.20  31   11.00 128    3.40  56    0.40  79    0.40
 19  103    0.40  30    0.40
 20   88   33.60  46   27.60 107   21.20  91   11.00 125    8.00  21    0.80  30    3.00  87    0.40
 21   69   66.40  85   66.20  23   28.40   1    3.80  28   12.40  54    3.40  22    7.60  58    0.80 123    0.80 167    0.80
 21   61    0.40  39    0.40 116    0.40 112    0.40  80    0.40
 22   56   61.80  28   61.60  88   26.00  58   17.00  45   11.00   3    6.80  23   10.60  85    6.40  30    3.80   2    1.20
 22   41    1.20  69    1.20   8    1.20  80    1.20 116    0.80 102    0.40
 23    2   52.20  30   44.60  85   35.20  58   16.20  41   15.40  28   12.80   3    8.00  88    8.00  80    1.20  45    0.80
 23   56    0.80  69    3.00  46    0.40 128    0.40 116    0.40
 24   33   83.00  88   11.80  87    8.80  30    6.00  56    0.40 128    0.40   3    0.40  61    0.40
 25   88   75.80  87   66.40  56   57.00  30   44.60   3   23.80 128    4.20  46    0.40  41    0.40
 26   22   85.00  23    0.80  85    0.80  28    0.80  31    0.40  93    0.40  82    0.40  26    0.40
```

27	2	66.40	30	63.80	23	23.40	85	6.40	91	1.20	28	3.40	46	7.60						
28	3	71.00	46	66.40	85	47.80	40	4.20	61	1.20	83	0.80	41	0.40	29	0.40	8	0.40		
29	6	47.60	2	35.40	56	29.00	46	27.80	85	24.80	61	6.80	91	1.60	128	1.60	37	17.00	40	1.20
29	8	7.60	3	0.40	90	0.40	116	0.40												
30	85	71.00	116	33.40	23	35.20	94	16.20	69	12.00	28	3.80	112	1.20	82	1.20	101	7.60	18	0.40
30	8	0.40	80	0.40	37	0.40														
31	2	52.40	46	44.60	85	32.80	3	18.80	23	17.40	45	0.40	8	0.40						
32	56	43.00	46	44.80	3	38.20	85	33.40	61	31.20	40	17.00	140	13.20	93	6.00	26	3.00	128	0.40
32	60	0.40	88	0.40	36	0.40														
33	81	71.00	113	33.40	52	2.00	23	8.40	182	4.20	39	4.20	36	1.60	14	3.40	80	3.40	68	0.80
33	56	0.40	40	0.40																
34	81	75.80	69	12.40	115	9.80	23	4.60	113	8.40	80	2.00	123	0.80	11	0.80	68	0.40	3	0.40
34	40	0.40	1	0.40	41	0.40	36	0.40	85	0.40	14	0.40								
35	3	75.80	81	26.40	115	27.60	85	19.20	23	13.60	40	2.00	88	8.40	36	1.60	156	1.60	14	3.80
35	80	1.20	103	1.20	56	3.00	68	0.40	61	0.40	134	0.40	123	0.40	69	0.40	39	0.40		
36	88	80.40	33	57.20	87	26.40	9	19.00	56	11.00	36	12.40	6	0.40	80	0.40	3	0.40		
37	88	75.60	91	33.60	106	41.80	43	17.40	97	3.80	6	3.40	56	0.40	5	0.40	8	0.40	9	0.40
37	109	0.40	36	0.40	103	0.40														
38	46	61.60	56	47.80	6	9.80	128	14.00	3	11.00	91	9.00	61	1.60	2	7.60	8	7.60	41	0.80
38	116	0.40	23	0.40	40	0.40	28	0.40	131	0.40	45	0.40								
39	41	63.80	46	63.40	140	38.20	91	14.00	6	11.40	109	6.40	107	17.00	131	0.80	3	0.40	56	0.40
40	6	52.20	3	47.60	88	47.60	46	47.60	140	14.40	41	18.60	56	15.60	98	3.40	85	3.40	30	0.80
40	45	0.40	61	0.40																
41	23	85.00	85	71.20	2	35.20	116	21.60	8	9.80	17	12.80	82	10.60	58	6.00	80	0.80	26	3.00
41	69	3.00	50	3.00	15	0.40	86	0.40	120	0.40	28	0.40								
42	22	80.40	8	23.60	36	16.60	40	11.40	103	7.20	61	6.40	37	6.40	23	1.20	3	0.80	85	0.80
42	56	0.40																		
43	8	57.00	30	49.80	46	31.00	28	20.80	36	7.20	103	4.60	3	13.60	56	10.60	40	1.20	45	3.00
43	61	0.40	91	0.40	85	0.40														
44	3	85.00	56	23.60	103	21.60	36	15.00	81	20.40	8	12.40	40	7.20	61	2.00	45	10.60	80	1.60
44	28	3.80	69	3.40	124	0.80	46	0.40	58	0.40										
45	46	71.20	91	25.80	30	12.80	102	3.40	87	3.00	45	0.40	56	0.40	3	0.40	71	0.40		
46	2	75.80	36	21.60	85	15.00	52	8.40	14	0.80	128	3.00	86	0.40						
47	107	57.20	67	52.40	88	33.40	104	12.40	125	3.80	46	7.60	45	3.00	62	0.40				
48	87	92.80	88	3.40	91	3.00														
49	87	95.40	88	0.80																
50	87	75.60	8	61.60	46	49.40	30	24.40	56	11.80	128	9.40	3	1.20	40	0.80	90	0.40	91	0.40
50	28	0.40																		
51	46	66.40	30	54.00	8	35.60	91	16.40	128	9.80	56	3.40	87	0.80	61	0.80	3	0.40	90	0.40

52	22	85.00	39	28.80	23	15.20	85	10.60	14	3.80	8	1.20	82	0.80	28	0.40	36	0.40		
53	85	66.60	16	59.20	23	21.20	8	23.00	39	12.40	28	12.40	2	13.20	82	1.60	116	3.80	58	0.80
53	3	0.80	103	0.40	123	0.40	156	0.40	120	0.40	69	0.40								
54	8	66.60	2	61.80	85	47.80	28	21.80	31	21.60	36	9.80	103	9.80	3	9.40	116	2.00	128	1.60
54	16	6.00	69	3.40	30	7.60	80	0.80	82	0.80	17	0.80	23	3.00	120	0.40	86	0.40	14	0.40
55	30	63.80	88	52.20	87	23.40	46	9.00	128	6.00	55	3.40	140	0.40	103	0.40	36	0.40	56	0.40
55	17	0.40	45	0.40																
56	87	75.80	88	23.80																
57	88	47.60	105	30.60	109	32.40	46	14.40	87	0.80	20	0.40								
58	105	75.80	107	37.40	19	1.60	88	3.80	43	1.20	46	3.40								
59	113	43.00	23	19.60	81	23.00	52	18.60	36	9.40	58	9.00	85	6.40	10	12.40	17	3.80	12	1.20
59	56	3.40	50	3.40	16	3.00	3	0.40	103	0.40	41	0.40	61	0.40						
60	10	71.20	52	42.80	103	11.40	36	1.60	81	6.00	85	3.40	17	0.80	3	0.80	58	0.80	56	3.00
60	16	3.00	39	0.40	110	0.40	80	0.40												
61	88	57.20	31	49.20	9	40.60	100	30.60	52	20.40	128	11.40	2	10.60	8	7.60	17	0.80	36	3.00
61	62	0.40	56	0.40	118	0.40	3	0.40	40	0.40	61	0.40	103	0.40						
62	91	85.00	88	75.80	107	17.00	125	3.00												
63	88	66.20	107	45.00	125	32.60	96	1.60	63	0.40										
64	73	75.80	22	71.00	85	16.20	16	11.40	2	6.40	14	3.40	39	0.80	28	0.40	116	0.40	8	0.40
64	3	0.40	80	0.40																
65	62	85.00	30	21.20	46	14.00	91	4.60	128	6.40	8	6.00	3	0.40	60	0.40	103	0.40		
66	107	35.40	91	18.80	67	1.60	46	12.40												
67	91	57.00	46	47.60	109	29.80	41	2.00	62	3.40	67	0.80	42	3.00	128	0.40				
68	88	80.40	91	61.60	46	29.00	62	28.00	107	0.80	67	0.40								
69	91	75.80	62	61.80	46	21.80	41	0.40	140	0.40										
70	23	85.00	39	85.00	7	43.00	14	12.40	76	3.80	113	3.00	11	0.40						
71	23	71.00	113	28.80	7	12.40	39	11.80	88	9.80	81	12.00	11	13.60	50	6.40	14	3.00	31	0.40
72	7	80.40	88	52.40	81	49.80	103	9.40	14	4.20	40	3.40	113	0.80	56	3.00	52	0.40	2	0.40
72	68	0.40	31	0.40	80	0.40														
73	7	80.40	88	57.20	78	7.20	41	4.60	31	0.40	120	0.40								
74	7	85.00	88	49.60	46	32.80	128	24.20	41	4.60	31	3.40	99	0.40	78	0.40	61	0.40		
75	113	85.00	52	7.20	16	6.40	36	1.20	61	0.80	23	0.80	10	3.00	81	3.00	128	0.40	80	0.40
75	50	0.40	14	0.40	116	0.40														
76	2	80.40	23	75.80	61	1.20	85	12.40	130	0.80	15	0.80	66	7.60	50	0.40	80	0.40	64	0.40
76	52	0.40	110	0.40																
77	2	80.40	66	21.20	7	9.80	31	6.40	61	1.20	40	0.80	102	0.80	128	0.80	29	3.00	52	0.40
77	80	0.40	85	0.40	116	0.40														
78	29	75.60	7	52.20	102	14.40	2	15.80	31	8.00	128	3.40								
79	2	75.80	82	26.40	112	29.40	94	4.60	28	4.20	120	1.60	23	6.00	123	1.20	116	0.80	14	0.80

79	95	0.80	18	3.00	38	3.00	61	0.40	3	0.40	80	0.40	53	0.40						
80	85	71.00	2	31.20	112	16.60	94	6.80	12	4.20	82	1.20	95	3.40	24	3.00	28	0.40	36	0.40
80	14	0.40	156	0.40																
81	23	46.40	7	21.60	85	29.80	28	24.80	31	9.00	12	1.20	116	1.20	120	1.20	80	0.80	9	0.40
81	22	0.40	36	0.40	56	0.40														
82	23	71.00	28	40.40	7	38.00	167	4.20	47	3.80	12	3.80	116	1.20	56	3.40	120	0.80	36	3.00
82	8	0.40	103	0.40																
83	28	85.00	7	12.40	14	12.40	52	4.20	31	3.40	88	0.80	116	0.40	12	0.40	2	0.40		
84	28	47.80	14	24.20	56	21.80	31	16.40	88	15.00	7	9.40	52	1.20	2	3.00	23	0.40	68	0.40
85	85	47.80	23	44.60	116	29.00	167	16.60	16	15.60	31	20.00	61	1.60	8	0.80	74	0.80	59	0.80
85	120	3.00	28	0.40	80	0.40	86	0.40	82	0.40										
86	23	78.80	120	17.00	116	17.00	167	16.60	39	12.00	85	11.40	72	17.00	8	3.40	31	7.60	128	0.80
86	82	0.80	127	0.80	28	3.00	16	3.00	57	0.40	95	0.40	61	0.40						
87	23	85.60	66	32.20	39	20.40	167	11.40	2	2.00	85	10.60	120	3.80	16	8.00	116	1.20	114	0.80
87	61	0.80	72	3.00	80	0.40	127	0.40	95	0.40	54	0.40	25	0.40						
88	47	52.20	56	40.40	28	23.40	71	9.80	158	0.80	41	0.80	103	3.00	31	3.00	85	0.40		
89	47	98.00	56	6.80	103	6.00														
90	47	59.60	31	40.40	103	14.00	85	6.40	88	10.60	56	7.60	71	0.80	28	3.00	158	0.40		
91	85	61.80	23	40.00	39	11.40	95	11.00	16	12.80	116	4.20	114	6.00	2	1.20	61	1.20	8	1.20
91	127	1.20	82	0.80	167	0.80	57	0.40	9	0.40	65	0.40	56	0.40						
92	31	40.40	103	19.20	12	0.40														
93	47	2.00	103	3.40	31	1.20	12	1.20												
94	47	14.40	2	3.40																
95	47	38.40	2	30.60	103	1.20	31	3.00												
96	2	17.00	47	24.80	103	11.00	31	3.80	56	7.60										
97	23	85.00	85	75.60	39	11.40	2	8.00	116	0.80	127	0.80	121	3.00	82	0.40	120	0.40	122	0.40
98	85	85.00	2	85.00	46	14.40	8	11.80	56	3.40	23	3.00	86	0.40	122	0.40	116	0.40	128	0.40
98	28	0.40	7	0.40	102	0.40														
99	91	80.40	128	42.80	30	37.20	62	28.00	46	11.80	56	23.00	8	0.80	7	0.80	41	0.80	31	3.00
99	97	0.40	102	0.40																
100	91	80.40	46	75.80	62	66.60	128	3.40	107	3.00										
101	91	85.00	46	80.40	62	33.40	107	20.00	88	15.40	41	0.40								
102	22	92.80	85	4.20	16	8.00	127	0.80	74	0.40	14	0.40	79	0.40						
103	8	61.80	103	61.80	52	49.40	56	35.20	128	15.00	55	18.80	91	11.00	23	15.20	121	1.60	116	1.20
103	34	3.40	61	0.80	37	3.00	80	0.40	86	0.40	68	0.40	123	0.40						
104	62	75.60	91	71.20	46	61.80	107	14.00	8	0.40										
105	8	85.00	56	80.40	6	33.60	40	33.60	91	11.80	122	4.20	57	11.00	23	12.40	62	0.80	128	3.00
105	61	0.40	121	0.40	58	0.40														
106	62	80.40	46	56.80	91	47.60	61	3.80	90	0.40	40	0.40	103	0.40						

107	2	71.00	102	52.40	7	32.60	8	17.00	56	21.40	46	23.00	90	2.00	9	3.80	55	1.20	128	3.40
107	51	3.00	40	0.40	23	0.40	97	0.40	85	0.40										
108	46	85.00	91	47.20	7	43.00	88	37.00	45	6.00	2	0.80	128	0.80	41	0.80	6	0.80	102	3.00
108	119	0.40	68	0.40	8	0.40														
109	46	57.20	88	57.00	128	3.40	41	3.00	91	0.40	35	0.40	140	0.40	7	0.40	119	0.40		
110	2	75.80	28	47.80	103	6.80	7	6.80	85	3.40	8	3.40	46	7.60	41	0.80	31	0.40	128	0.40
110	58	0.40																		
111	113	43.00	11	24.40	23	18.80	80	2.00	36	4.20	69	1.20	3	3.40	61	0.40	14	0.40	116	0.40
111	56	0.40	120	0.40																
112	23	38.40	113	28.80	38	19.20	11	22.80	7	9.40	69	2.00	36	4.20	80	0.80	81	0.80	61	0.80
112	82	0.40	116	0.40	52	0.40	58	0.40	29	0.40										
113	23	80.40	29	40.60	116	24.40	56	13.60	81	11.40	7	7.20	120	1.60	69	1.20	103	0.80	22	0.80
113	36	0.80	8	0.40	3	0.40	86	0.40	85	0.40	61	0.40	41	0.40						
114	56	62.00	23	61.80	41	33.40	29	23.80	8	12.40	58	9.40	116	2.00	69	2.00	3	4.20	14	1.60
114	103	3.80	28	3.40	36	0.40														
115	29	80.40	23	14.00	8	9.80	103	6.40	41	3.40	61	0.80	31	3.00	7	0.40				
116	29	51.40	103	30.60	44	28.00	6	27.60	31	15.40	41	1.60	7	1.60	88	1.20				
117	88	85.00	41	0.80	77	0.80														
118	88	80.40	107	25.20	89	0.80	124	3.00	103	0.40										
119	23	80.40	85	21.20	36	9.80	13	4.60	52	15.40	128	8.40	56	1.20	61	0.80	116	0.40	86	0.40
119	31	0.40	12	0.40																
120	29	66.40	52	33.40	56	26.40	23	28.00	103	20.40	89	11.40	61	0.40	34	0.40	8	0.40		
121	160	95.40	34	12.40	124	8.00	69	1.20	97	1.20	8	3.00	55	0.40						
122	91	71.20	63	57.20	43	0.80														
123	10	80.40	14	15.00	119	9.80	121	1.60	8	1.20	101	3.40	80	0.40	48	0.40	81	0.40	52	0.40
124	88	43.00	10	44.60	23	26.20	81	16.00	14	9.40	121	2.00	8	2.00	22	6.00	86	1.20	113	0.80
124	61	0.40	52	0.40	36	0.40	56	0.40	37	0.40	119	0.40								
125	87	78.40	88	11.00	36	0.80	14	0.40	8	0.40	55	0.40								
126	87	85.00	88	80.40	61	0.40	34	0.40	3	0.40	60	0.40								
127	106	80.40	88	75.80	91	0.80														
128	22	43.00	2	26.40	8	26.20	23	26.00	61	18.60	85	14.40	70	11.40	56	3.80	102	3.80	40	1.20
128	32	3.40	52	0.80	120	0.80	117	3.00	116	3.00	46	3.00	122	0.40	91	0.40	58	0.40	140	0.40
129	85	61.80	8	63.40	61	19.00	32	23.00	40	6.80	70	6.40	56	8.00	28	7.60	102	3.00	118	3.00
129	23	0.40	93	0.40	116	0.40	160	0.40												
130	85	61.80	8	61.80	56	52.40	93	9.40	103	1.20	28	3.40	32	0.80	87	0.80	40	0.80	118	0.40
130	122	0.40	126	0.40	36	0.40														
131	88	80.40	109	66.40	91	6.80	21	0.40												
132	109	42.80	88	24.20	107	21.60	67	7.20	106	12.40										
133	22	45.00	85	38.00	16	23.40	23	14.00	28	24.80	82	3.40	10	3.00	8	3.00	36	0.40	71	0.40

133   14   0.40
134   85   85.00   8   30.80 16   30.60 61   1.20 36   0.80   1   0.80   9   0.80 103   0.80 28   3.00 21   0.40
134 119   0.40 14   0.40
135   30   35.80   2   23.40 108   29.40 56   6.80   8   11.00 46   10.60 28   7.60 103   0.80 85   3.00 128   3.00
135   3   0.40 58   0.40
136 108   42.20 30   35.80 46   24.60 90   0.80 56   0.80   5   0.40 71   0.40   2   0.40   3   0.40 17   0.40
00
AchimillAgrosmitAgrohyemAlistrivAmaranspAlopcaroAmbrgrayAmbrpsilAmbrtrifAndrgera
AndrscopApoccannArteludoAsclsyriAsclvertAsteericAstesimpAstrcrasBacorotuBidecern
BidefronBrominerBromjapoCalalongCallinvoCardnutaCannsatiCarebrevCarelaevCarelanu
CarestipCaretribCalacanaChenalbuChendessCirsaltiCirscaneCarexxspConvarveConycana
CoretincEchinospEchimuriEleoerthEleoacicEleomacrEleosmalElymcanaElymvirgErigstri
FraxpennGaliaparGaurcoccHedehispHeliannuHordjubaHordpusiJuncinteKuhneupaLamiacea
LactucspLeeroryzLeptfascLinurigiLithinciLippcuneLemnminoLepivirgLotupursLycoamer
MarsvestMedisatiMelioffiMiranyctMorualbaMuhlmexiMuhlraceMyosminiNepecataOxalstri
PanivirgDicaoligParipensPoacomprPoapratePhysvirgPhalarunPolyamphPolypersPolypens
PolygsppPopudeltPotenorvPsorargoRaticoluRicciaspRoripaluRorisessRorisinuRorippsp
RosaarkaRumealtiRumecrisSagirigiSagilatiScirfluvScirpuspSparpectSpareurySolicana
SolimissSolirigiSorgnutaSphacoccSpheobtuTaraoffiStacpaluTeuccanaThlaarveTragdubi
TrifpratTrifrepeTrioperfTyphanguTyphlatiTyphaxspVerbstriVernfascVeropereViciamer
XantstruAgrostolAmmacoccAmarrudiAstejuncAsterxspAzolmexiBeruerecBidecomoBoltaste
BoutcurtConyramoCusccurtCypeacumCypearisCypelupuEuphdentEuphglypEuphmacuHelipeto
HelianspLactserrMiralinePanicapiPanidichPhyslongPolyalbaPolybicoPolyhydrPolylapa
PolypuncPolyramoRiccfluiRicciospSetaglauSpirpolySporaspeStroleioVerbbracVernbald
VerbhastBryophytSolainteAbuttheoBasimyceBuchdactCyperuspAlissubcEuphnutaLichenxx
LinddubiMelialbaPhlepratPotanodoPsortenuSilplaciLiverworWolfcoluUtrivulgCypeeryt
EuphcyatEuphmargGrinsguaHetelimoMollvertPrunamerSolarost
001Andge002Panvi003Horju004Horju005Ambgr006Ambgr007Corti008Polam009Polam010Broin
011Phaar012Phaar013Scifl014Polam015Broja016Sornu017Elyvi018Ambps019Elema020Polam
021Poapr022Horju023Agrsm024Calca025Polam026Broin027Agrsm028Agrhy029Aloca030Poapr
031Agrsm032Elema033Panvi034Panvi035Agrhy036Polam037Polam038Elema039Corti040Aloca
041Broja042Broin043Ambps044Agrhy045Elema046Agrsm047Scspp048Phaar049Phaar050Phaar
051Elema052Broin053Poapr054Ambps055Carln056Phaar057Polam058Sagla059Sornu060Andge
061Polam062Pospp063Polam064Melof065Leeor066Scspp067Pospp068Polam069Pospp070Broja
071Broja072Ambgr073Ambgr074Ambgr075Sornu076Agrsm077Agrsm078Carlv079Agrsm080Poapr
081Broja082Broja083Carbr084Carbr085Poapr086Broja087Broja088Elesm089Elesm090Elesm
091Poapr092Carst093Rumcr094Elesm095Elesm096Elema097Broja098Poapr099Pospp100Pospp
101Pcspp102Broin103Ambps104Leeor105Ambps106Leeor107Agrsm108Elema109Elema110Agrsm
111Sornu112Broja113Broja114Horju115Carlv116Carlv117Polam118Polam119Broja120Carlv

121Pollal22Pospp123Andge124Andge125Phaar126Phaar127Scifl128Broin129Ambps130Poapr
131Polam132Spaeu133Broin134Poapr135Carln136Spape

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(I3,2X,10(I3,1X,F7.2,1X))                                          10
  1  101    38.00 106    15.00  82    15.00  88     2.00
  2   52    38.00  82    38.00 106    15.00  88     2.00  71     2.00
  3   82    98.00
  4  106    62.00  88    38.00  82    15.00
  5   88    62.00  52     2.00
  6  106    62.00  82    15.00  88     2.00  71     2.00
  7  106    85.00  71     2.00
  8  120    62.00  82    15.00
  9  120    62.00  82    15.00
 10   88    38.00 106    15.00  52    15.00  82     2.00  69     2.00
 11   60    85.00  52    15.00  47     2.00
 12   47    85.00  72    15.00  88    15.00  60     2.00  86     2.00
 13   60    38.00  47    15.00  15    15.00  52    15.00  43     2.00
 14   43    15.00  47    15.00  52    15.00  15     2.00  60     2.00  72     2.00
 15   72    38.00  47    15.00  52    15.00  60     2.00  43     2.00  15     2.00
 16   56    38.00
 17   35    98.00
 18   35    38.00  43    38.00  80    15.00  47    15.00  56    15.00
 19   35    38.00  43    15.00  89    15.00  56    15.00
 20   56    85.00  14     2.00
 21   56    85.00  92    15.00  14     2.00  25     2.00
 22   56    62.00 105    15.00  80    15.00  91     2.00  60     2.00  92     2.00  46     2.00  49     2.00  15     2.00
 23  105    62.00  91    15.00  92     2.00  46     2.00  11     2.00  60     2.00  49     2.00
 24   46    62.00   8    15.00  92    15.00  91    15.00
 25  111    98.00
 26   80    62.00 125     2.00  11     2.00  42     2.00  48     2.00  15     2.00  92     2.00  84     2.00  25     2.00
 27   92    38.00  91    38.00   5    15.00  80    15.00  70    15.00  60     2.00
 28  105    85.00  70    38.00  87    15.00  80     2.00  92     2.00
 29   80    38.00  87    15.00  92    15.00
 30   27    98.00  16     2.00  85     2.00  19     2.00  39     2.00  37     2.00
 31   85    85.00  29    15.00  32    15.00   4     2.00   6     2.00  27     2.00  19     2.00  37     2.00
 32   14    62.00  85    38.00  42     2.00  25     2.00  22     2.00 105     2.00
 33   92    85.00 106    15.00
 34  105    38.00  92    15.00  49    15.00
 35   84    85.00  81    15.00 110    15.00  68     2.00
 36   52    85.00  42    62.00  82    38.00  47    38.00  22     2.00  92     2.00
 37   46    62.00  22     2.00  84     2.00   6     2.00  80     2.00   8     2.00  92     2.00  58     2.00
 38   92    62.00  11    38.00  80    15.00  49    15.00  47     2.00  82     2.00  84     2.00   6     2.00
```

39	92	85.00	105	62.00																
40	8	15.00	11	15.00	6	15.00	7	15.00	67	15.00	82	2.00	92	2.00	114	2.00				
41	92	62.00	47	15.00	82	15.00	80	15.00	6	15.00	7	15.00	41	2.00	84	2.00				
42	82	98.00																		
43	46	38.00	92	15.00	13	15.00	48	2.00	99	2.00										
44	93	62.00	46	15.00	13	15.00	32	2.00												
45	56	38.00	11	15.00	8	2.00	50	2.00	43	2.00	32	2.00	48	2.00	7	2.00	92	2.00		
46	46	15.00	92	2.00																
47	126	85.00	1	2.00																
48	92	38.00	57	2.00	93	2.00	11	2.00	68	2.00	97	2.00	26	2.00	10	2.00	42	2.00	41	2.00
48	94	2.00																		
49	47	2.00																		
50	111	62.00	80	2.00	14	2.00	47	2.00												
51	52	62.00	47	38.00	32	15.00	44	15.00	84	15.00	124	2.00	15	2.00	72	2.00	87	2.00	70	2.00
52	112	62.00	61	62.00	47	15.00	72	2.00	62	2.00	102	2.00								
53	92	38.00	52	38.00	87	15.00	44	15.00	124	2.00	99	2.00								
54	105	85.00	70	85.00	103	38.00	92	2.00	102	2.00	46	2.00								
55	111	85.00																		
56	92	38.00	42	15.00	47	15.00	49	2.00	46	2.00										
57	82	85.00	32	15.00	68	2.00	31	2.00	99	2.00										
58	106	62.00	120	15.00	14	2.00	77	2.00												
59	106	85.00	92	15.00																
60	85	85.00	123	2.00	115	2.00	68	2.00	109	2.00	20	2.00	12	2.00	23	2.00	39	2.00		
61	45	62.00	90	15.00	108	15.00	88	15.00	14	2.00	10	2.00	59	2.00	81	2.00	26	2.00	68	2.00
61	11	2.00																		
62	59	62.00	108	38.00	87	38.00	33	15.00	45	15.00	67	2.00	8	2.00	11	2.00	14	2.00		
63	49	62.00	10	38.00	11	15.00	79	2.00	100	2.00	87	2.00								
64	117	38.00	8	15.00	92	15.00	30	2.00	6	2.00										
65	111	98.00																		
66	14	85.00	92	62.00	63	15.00	36	15.00	68	2.00										
67	92	62.00	9	15.00	14	2.00														
68	3	85.00	10	2.00	83	2.00	68	2.00	41	2.00	20	2.00								
69	100	38.00	42	38.00	82	15.00	41	15.00	10	2.00	90	2.00	108	2.00	45	2.00	4	2.00	67	2.00
69	12	2.00	63	2.00																
70	100	38.00	88	38.00	82	38.00														
71	119	62.00	92	15.00	87	15.00	82	15.00	100	2.00	90	2.00	70	2.00	88	2.00				
72	82	85.00	88	15.00	100	15.00	90	2.00	118	2.00										
73	90	62.00	103	15.00	45	15.00	70	2.00	100	2.00										
74	119	85.00	70	2.00	45	2.00														

75	46	38.00	119	38.00	90	15.00	70	2.00												
76	119	15.00	87	15.00	70	2.00	90	2.00	100	2.00	25	2.00								
77	100	38.00	90	38.00	70	15.00	25	2.00	15	2.00	66	2.00	102	2.00	45	2.00				
78	45	85.00	55	2.00	91	2.00	15	2.00	100	2.00										
79	126	98.00																		
80	45	38.00	91	38.00	10	15.00	125	2.00	26	2.00										
81	87	38.00	42	15.00	45	15.00	8	2.00	10	2.00	21	2.00	124	2.00	91	2.00	81	2.00	100	2.00
81	26	2.00																		
82	49	38.00	81	15.00	45	15.00	4	2.00	85	2.00	87	2.00	42	2.00						
83	10	38.00	12	15.00	59	2.00	124	2.00	91	2.00	33	2.00	63	2.00	85	2.00	20	2.00	41	2.00
84	90	38.00	45	38.00																
85	111	98.00																		
86	81	85.00	10	15.00	2	2.00	17	2.00	85	2.00	28	2.00								
87	33	38.00	10	15.00	28	15.00	87	15.00	59	2.00	63	2.00	108	2.00						
88	49	62.00	10	38.00	63	15.00	33	15.00	124	2.00	100	2.00	42	2.00	87	2.00	12	2.00	88	2.00
89	105	85.00	87	15.00	10	15.00	124	2.00	108	2.00										
90	45	38.00	87	38.00	82	15.00	49	2.00	103	2.00	70	2.00								
91	49	62.00	87	15.00	103	15.00														
92	105	38.00	119	15.00	49	15.00	87	15.00	102	15.00										
93	49	85.00	87	15.00	45	2.00	103	2.00	118	2.00	55	2.00	90	2.00	10	2.00				
94	82	85.00	49	15.00	87	2.00	45	2.00	10	2.00										
95	82	15.00	85	15.00	81	15.00	115	2.00	4	2.00	64	2.00	28	2.00	87	2.00	10	2.00		
96	27	85.00	81	15.00	82	2.00	10	2.00												
97	110	38.00	81	15.00	3	15.00	17	15.00	78	2.00	85	2.00	59	2.00						
98	93	38.00	34	15.00	121	15.00	33	2.00	54	2.00										
99	85	62.00	33	15.00	10	15.00	28	15.00	92	15.00	96	2.00	38	2.00						
100	33	62.00	87	38.00	12	15.00	10	2.00												
101	87	38.00	33	38.00	28	38.00	12	15.00	59	15.00	14	2.00	10	2.00						
102	111	98.00	56	98.00																
103	27	85.00	98	2.00																
104	82	62.00	88	38.00	33	38.00	100	2.00	42	2.00	45	2.00	113	2.00	8	2.00				
105	51	62.00	88	15.00	82	15.00	102	15.00	104	2.00										
106	102	85.00	107	15.00	51	15.00	33	15.00												
107	87	38.00	51	38.00	48	38.00	45	2.00	15	2.00										
108	45	85.00	48	15.00	51	15.00	87	15.00	90	2.00										
109	126	98.00																		
110	87	98.00	18	15.00	113	2.00														
111	27	38.00	85	38.00	41	15.00	116	15.00	12	2.00	23	2.00	42	2.00						
112	5	15.00	52	15.00	101	15.00	15	2.00	25	2.00	60	2.00	32	2.00	71	2.00				

113	5	38.00	101	15.00	74	2.00	15	2.00	97	2.00	71	2.00	52	2.00
114	75	62.00	5	15.00	52	15.00	60	2.00	15	2.00	101	2.00	71	2.00
115	89	38.00	101	15.00	71	15.00	60	2.00	52	2.00				
116	106	15.00	52	15.00	71	15.00	89	2.00	95	2.00				
117	106	62.00	87	15.00	71	2.00								
118	89	38.00	47	2.00	86	2.00								
119	32	15.00	89	15.00										
120	71	85.00	122	62.00	87	38.00	112	38.00						
121	122	62.00	87	38.00	112	15.00	71	15.00						
122	106	85.00	71	62.00	87	15.00								
123	89	98.00												
124	25	62.00	89	15.00	47	15.00	72	15.00	60	2.00	15	2.00	65	2.00
125	72	38.00	47	38.00	25	38.00	15	15.00	50	15.00	73	2.00	65	2.00
126	47	38.00	35	38.00	15	2.00	50	2.00	97	2.00				
127	47	62.00	72	15.00	35	2.00	15	2.00						
128	82	85.00	89	15.00	52	15.00	42	2.00	43	2.00	50	2.00	116	2.00
129	82	38.00	89	38.00	50	15.00	52	15.00	101	15.00				
130	82	38.00	122	38.00	89	15.00	52	15.00	60	2.00	24	2.00	101	2.00
131	122	38.00	106	15.00	82	15.00	24	15.00	101	2.00				
132	122	38.00	82	38.00	50	15.00	101	15.00	52	2.00	89	2.00		
133	24	85.00	112	62.00	52	15.00	60	15.00	101	2.00	15	2.00	89	2.00
134	24	62.00	25	62.00	60	15.00	101	15.00						
135	42	85.00	76	62.00	92	38.00	69	15.00	23	2.00	75	2.00	53	2.00
136	106	62.00	89	38.00	42	38.00	69	2.00	23	2.00				

00
AbuttheoAgrocrisAgrointeAgrosmitAlistrivAlopcaroAloppratAmaranspAmbrarteAmbrgray
AmbrpsilAmbrosspAmbrtomeAmbrtrifAmmacoccAmorcaneAndrgeraApoccannArisoligAsclsyri
AsteericAstesimpAsterxspAzolmexiBacorotuBidefronBromінerBromjapoBromtectCannsati
CardnutaCarexxspCarevulpCeltocciChenalbuChenopspCirsarveCirsiuspConvarveConvolsp
ConycanaCoretincCypeacumCypeescuEchicrusEchimuriEchinospEleoacicEleomacrEleoobtu
EleosmalEleochspFragvirgGledtriaGlycerspGlycimaxGrinsquaHeliannuHelianspHetelimo
HetepeduHeteraspHordjubaJuncdudlJuncinteJuncusspKochscopLactucspLeeroryzLemnmino
LemnaxspLeptfasiLinddubiLudwpaluMarsvestMuhlenspNepecataOxalstriPanicapiPanidich
PanivirgPhalarunPhysvirgPoacomprPoapratePoaceaexPolyamphPolybicoPolyhydrPolylapa
PolypensPolygospPopudeltPortolerPotagramRhusxxspRorripspRosaarkaRumealtiRumecris
SagilatiSagittspSciracutScirpungScirfluvScirpsppScirpuspSetarispSolidaspSorgnuta
SorghsppSpareurySparpectTaraoffiTragopspTrifrepeTritaestTyphanguTyphglauTyphlati
UlmupumiUtrivulgVerbenspVernfasiXantstruZeaxmays
001Sagla002Phaar003Phaar004Scspp005Polbi006Scspp007Scspp008Typla009Typla010Polbi

011Hetli012Echsp013Hetli014Echsp015Lepfa016Glyma017Cheal018Cheal019Cheal020Glyma
021Glyma022Glyma023Scifl024Echmu025Sospp026Pandi027Polsp028Scifl029Pandi030Broin
031Poapr032Ambtr033Polsp034Scifl035Poaco036Elesp037Echmu038Polsp039Polsp040Ambps
041Polsp042Phaar043Echmu044Popde045Glyma046Echmu047Zeama048Polsp049Echsp050Sospp
051Elesp052Spaeu053Polsp054Scifl055Sospp056Polsp057Phaar058Scspp059Scspp060Poapr
061Echcr062Helsp063Elema064Triae065Sospp066Ambtr067Polsp068Agrin069Rumcr070Rumcr
071Typgl072Phaar073Polla074Typgl075Typgl076Typgl077Polla078Echcr079Zeama080Echcr
081Polam082Elema083Ambgr084Polla085Sospp086Panvi087Carvu088Elema089Scifl090Echcr
091Elema092Scifl093Elema094Phaar095Phaar096Broin097Sornv098Popde099Poapr100Carvu
101Polam102Sospp103Broin104Phaar105Elesm106Sagsp107Polam108Echcr109Zeama110Polam
111Broin112Alitr113Alitr114Marve115Polhy116Scspp117Scspp118Polhy119Polhy120Lemsp
121Utrvu122Scspp123Polhy124Bacro125Lepfa126Echsp127Echsp128Phaar129Phaar130Phaar
131Utruv132Phaar133Spaeu134Azome135Corti136Scspp

Appendix A-3. HARVARD data matrix.

(I3,2X,10(I3,1X,F7.2,1X)) 10

1	9	52.40	66	29.00	50	14.00	37	7.20	10	10.60	25	1.20	72	7.60	36	0.80	74	0.40		
2	50	61.60	9	14.00	13	9.80	10	3.80	66	3.40	72	3.40	25	0.80	38	0.40	12	0.40		
3	36	35.20	20	28.00	23	27.60	50	23.00	7	11.40	13	6.40	2	6.40	25	3.40	52	3.00	32	3.00
3	66	0.40	26	0.40	1	0.40	45	0.40	38	0.40	47	0.40	62	0.40						
4	36	85.00	6	52.40	66	17.00	7	23.40	63	0.40	20	0.40.	2	0.40						
5	6	85.00	7	35.80	31	23.40	66	9.40	41	2.00	3	4.20	33	1.20	2	7.60	36	0.80	19	0.40
6	6	75.80	43	66.60	2	43.00	7	37.40	36	4.20	41	1.60	66	1.60	33	1.20	3	3.40	19	0.80
6	46	0.40	27	0.40																
7	27	66.40	56	44.60	42	7.20	79	4.20	66	6.40	54	12.40	33	3.40	19	0.80	31	0.80	64	0.40
7	4	0.40																		
8	54	71.00	27	28.40	64	4.60	56	20.00	42	1.20	79	0.40	59	0.40						
9	54	75.60	68	57.00	56	40.40	27	13.60	64	4.60	42	1.60	4	0.40	59	0.40	66	0.40		
10	9	75.60	50	23.80	66	9.40	25	1.60	47	1.20	13	3.40	24	3.00	27	3.00	11	0.40	72	0.40
10	10	0.40	65	0.40																
11	9	80.40	13	33.40	50	9.00	10	3.80	66	1.20	26	0.40	25	0.40	27	0.40	32	0.40	47	0.40
11	72	0.40																		
12	50	61.80	23	20.40	69	6.80	47	4.20	20	6.40	32	3.40	36	3.40	51	0.80	7	0.80	80	0.40
12	48	0.40	6	0.40	77	0.40	17	0.40	55	0.40	26	0.40	9	0.40	66	0.40	2	0.40	61	0.40
13	36	80.40	6	75.80	7	26.00	66	1.20	26	0.80	27	0.80	19	3.00	47	0.40				
14	6	71.20	7	61.60	48	28.80	34	21.60	27	19.60	66	9.40	16	6.80	47	2.00	49	1.60	36	1.60
14	69	3.80	31	3.80	55	1.20	30	3.40	2	0.80	21	0.80	19	3.00	26	0.40	61	0.40	28	0.40
15	7	52.40	6	42.80	27	33.80	43	27.60	2	14.40	16	8.80	48	8.80	33	4.60	19	9.00	21	4.20
15	30	3.80	66	1.20	47	1.20	55	0.80	63	0.80	49	0.40	61	0.40						
16	27	61.80	55	61.60	49	47.60	42	38.20	58	38.00	29	15.00	31	7.20	19	4.60	15	4.20	8	4.20
16	48	6.40	16	1.20	44	0.80	64	0.80	30	0.40										
17	54	71.20	55	52.40	58	11.80	27	3.80	30	1.20	57	3.40	49	0.80	64	0.80				
18	57	61.60	54	33.60	58	26.00	55	19.60	68	19.20	30	0.80	27	0.40	64	0.40	66	0.40	49	0.40
19	9	35.60	66	19.00	50	8.40	37	2.00	13	1.60	43	0.40	72	0.40	36	0.40	27	0.40	47	0.40
19	25	0.40																		
20	9	33.60	50	21.20	13	4.60	66	3.40	10	1.20	2	1.20	70	0.80	37	0.80	79	0.80	56	0.40
20	17	0.40	31	0.40	12	0.40	36	0.40	72	0.40										
21	7	28.20	23	27.80	50	23.40	20	11.00	47	1.60	36	3.80	2	3.80	66	3.40	77	3.40	13	0.80
21	22	3.00	9	3.00	37	0.40	43	0.40	17	0.40	51	0.40	53	0.40	56	0.40	32	0.40	19	0.40
21	45	0.40																		
22	73	38.00	36	28.20	66	9.80	6	7.20	16	0.80	14	0.40	19	0.40	53	0.40	40	0.40		
23	31	11.40	40	2.00	66	1.60	73	0.80	19	0.40	27	0.40								
24	19	1.20	40	1.20	42	0.40	31	0.40												
25	31	1.60	40	1.20	73	1.20	42	0.80	19	0.40	66	0.40								
26	54	52.40	40	2.00	73	2.00														

27 54 18.20 68 11.40 73 7.20 40 2.00
28 9 71.00 50 14.40 13 4.60 66 2.00 2 1.20 72 0.80 24 3.00 37 0.40 71 0.40 10 0.40
28 61 0.40
29 9 80.40 13 14:00 50 7.20 72 3.80 60 0.80 2 0.80 70 0.40 71 0.40 32 0.40 12 0.40
30 50 52.40 7 38.20 23 13.20 69 4.60 9 1.60 2 1.60 13 1.60 47 0.80 26 0.80 20 0.80
30 66 0.40 33 0.40 51 0.40 36 0.40 12 0.40 17 0.40 75 0.40 48 0.40 25 0.40 72 0.40
30 78 0.40
31 6 57.00 36 24.20 7 11.40 18 4.60 66 1.60 48 1.60 27 3.80 55 1.20 5 1.20 23 0.80
31 19 0.80 31 3.00 2 0.40 57 0.40
32 31 26.20 66 4.60 8 4.20 19 3.80 27 1.60 35 0.80 6 0.80 78 0.40 67 0.40
33 14 16.60 19 16.60 8 2.00 15 1.60 31 1.20 39 0.80 67 0.40 35 0.40 78 0.40
34 14 98.00 40 2.00 19 2.00 31 1.60 39 0.80 73 0.80 54 0.40 76 0.40
35 14 90.20 54 75.80 40 7.20 73 1.60 76 0.40 31 0.40
36 40 98.00 68 35.60 54 26.40 73 2.00 14 1.60
00
AgrosmitAgrohyemAlopcaroAmaranspAmarrudiAmbrgrayAmbrpsilAmmacoccAndrgeraAndrscop
ApoccannAsclsyriAsteericAzolmexiBacorotuBeruerecBidecomoBidefronBoltasteBromjapo
BryophytCarebrevCarelanuCarexxspCirsaltiConycanaCoretincCypeacumCypearisEchimuri
EleomacrElymcanaHeliannuHelipetoHetelimoHordjubaJuncinteLactucspLeeroryzLemnmino
LepivirgLeptfascLotupursMarsvestMorualbaMyosminiOxalstriPanicapiPanidichPanivirg
PhyslongPoacomprPoapratePolyamphPolybicoPolygsppPolyhydrPolylapaPolypensPolypunc
PolyramoPopudeltPotenorvRorisinuRumealtiRumecrisSagilatiScirfluvSetaglauSilplaci
SolicanaSorgnutaSpirpolyTaraoffiTeuccanaUtrivulgVerbhastVernfascVeropereStroleio
101Andge102Panvi103Horju104Horju105Ambgr106Ambgr107Corti108Polam109Polam201Andge
202Andge203Panvi204Horju205Ambgr206Ambps207Corti208Polam209Polhy301Andge302Andge
303Ambps304Spipo305Elema306Bolas307Elema308Polam309Polam401Andge402Andge403Panvi
404Ambgr405Elema406Azome407Azome408Azome409Lemmi

Appendix B. Plant records from Rainwater Basin ordination studies.

User notes:

1. Plant names include records from field studies of August 1986, June 1987 and August 1987 not discussed in this report.

2. Column headers are described as follows:

HR - indicator status used for plant record

Plant record name - self explanatory

Abbrev. name (8-character) - genus/species or plant record abbreviation used for species field in sample-by-species matrices (see Appendices A-1 through A-3).

Common name - assignment of a common name was based upon the Great Plains Flora Association (1977, 1986) or Sutherland (1986).

Family - self explanatory

Abbrev. (5-character) - genus/species or plant record abbreviation used for ordination diagrams in the text; also used as a descriptor of the dominant species occurring at a sample location for the sample-by-species matrices (see Appendices A-1 through A-3).

3. Plant record *Polygonum spp.* denotes either *P. bicorne, P. persicaria or P. lapathifolium.* Voucher specimens from selected sites could not be differentiated taxonomically.

4. Plant record *Scirpus spp.* denotes either *S. acutus* or *S. validus.* For selected study sites voucher specimens indicated hybridization (Sutherland pers.comm). *S. acutus* or *S. validus* was used as a valid record when differentiated taxonomically.

HR	PLANT RECORD NAME	ABBREV. NAME [8 CHARACTER]	COMMON NAME	FAMILY	ABBREV. [5 CHARACTER]
4	*'Abutilon theophrasti'*	'Abuttheo'	velvetleaf	Malvaceae	
4	*'Achillea millefolium'*	'Achimill'	yarrow	Asteraceae	
2	*'Agropyron cristatum'*	'Agrocris'	crested wheatgrass	Poaceae	
2	*'Agropyron intermedium'*	'Agrointe'	intermediate wheatgrass	Poaceae	Agrin
5	*'Agropyron smithii'*	'Agrosmit'	western wheatgrass	Poaceae	Agrsm
7	*'Agrostis hyemalis'*	'Agrohyem'	ticklegrass	Poaceae	Agrhy
6	*'Agrostis stolonifera'*	'Agrostol'	redtop	Poaceae	
8	*'Alisma subcordatum'*	'Alissubc'	water plantain	Alismataceae	
8	*'Alisma triviale'*	'Alistriv'	water plantain	Alismataceae	Alitr
7	*'Alopecurus carolinianus'*	'Alopcaro'	Carolina foxtail	Poaceae	Aloca
7	*'Alopecurus pratensis'*	'Alopprat'	meadow foxtail	Poaceae	
6	*'Amaranthus rudis'*	'Amarrudi'	waterhemp	Amaranthaceae	
5	*'Amaranthus sp.'*	'Amaransp'	pigweed	Amaranthaceae	
3	*'Ambrosia artemisiifolia'*	'Ambrarte'	common ragweed	Asteraceae	
6	*'Ambrosia grayi'*	'Ambrgray'	bur ragweed	Asteraceae	Ambgr
5	*'Ambrosia psilostachya'*	'Ambrpsil'	western ragweed	Asteraceae	Ambps
5	*'Ambrosia sp.'*	'Ambrossp'	ragweed	Asteraceae	
2	*'Ambrosia tomentosa'*	'Ambrtome'	perennial bursage	Asteraceae	
6	*'Ambrosia trifida'*	'Ambrtrif'	giant ragweed	Asteraceae	Ambtr
8	*'Ammannia coccinea'*	'Ammacocc'	toothcup	Lythraceae	
2	*'Amorpha canescens'*	'Amorcane'	lead plant	Fabaceae	
4	*'Andropogon gerardii'*	'Andrgera'	big bluestem	Poaceae	Andge
3	*'Andropogon scoparius'*	'Andrscop'	little bluestem	Poaceae	
5	*'Apocynum cannabinum'*	'Apoccann'	Indian hemp dogbane	Apocynaceae	
2	*'Aristida oligantha'*	'Arisolig'	prairie three-awn	Poaceae	
3	*'Artemesia ludoviciana'*	'Arteludo'	white sage	Asteraceae	
4	*'Asclepias syriaca'*	'Asclsyri'	common milkweed	Asclepiadaceae	
4	*'Asclepias verticillata'*	'Asclvert'	whorled milkweed	Asclepiadaceae	
3	*'Aster ericoides'*	'Asteeric'	white aster	Asteraceae	
7	*'Aster junciformis'*	'Astejunc'	rush aster	Asteraceae	
7	*'Aster simplex'*	'Astesimp'	panicled aster	Asteraceae	
5	*'Aster sp.'*	'Asterxsp'	wild aster	Asteraceae	
5	*'Astragalus crassicarpus'*	'Astrcras'	ground-plum	Fabaceae	
9	*'Azolla mexicana'*	'Azolmexi'	water fern	Salviniaceae	Azome
8	*'Bacopa rotundifolia'*	'Bacorotu'	water hyssop	Scrophulariaceae	Bacro
6	'Basidiomycete'	'Basimyce'	mushroom	-	
7	*'Berula erecta'*	'Beruerec'	water parsnip	Apiaceae	
7	*'Bidens cernua'*	'Bidecern'	nodding beggarticks	Asteraceae	
7	*'Bidens comosa'*	'Bidecomo'	leafy-bracted beggarticks	Asteraceae	
7	*'Bidens frondosa'*	'Bidefron'	beggarticks	Asteraceae	

HR	PLANT RECORD NAME	ABBREV. NAME	COMMON NAME	FAMILY	ABBREV.
7	*'Boltonia asteroides'*	'Boltaste'	violet or white boltonia	Asteraceae	Bolas
2	*'Bouteloua curtipendula'*	'Boutcurt'	sideoats grama	Poaceae	
4	*'Bromus inermis'*	'Brominer'	smooth brome	Poaceae	Broin
5	*'Bromus japonicus'*	'Bromjapo'	Japanese brome	Poaceae	Broja
2	*'Bromus tectorum'*	'Bromtect'	downy brome	Poaceae	
5	'Bryophyte'	'Bryophyt'	moss	-	
2	*'Buchloe dactyloides'*	'Buchdact'	buffalo grass	Poaceae	
7	*'Calamagrostis canadensis'*	'Calacana'	bluejoint	Poaceae	Calca
3	*'Calamovilfa longifolia'*	'Calalong'	prairie sandreed	Poaceae	
5	*'Callirhoe involucrata'*	'Callinvo'	purple poppy mallow	Malvaceae	
5	*'Cannabis sativa'*	'Cannsati'	hemp, marijuana	Cannabaceae	
4	*'Carduus nutans'*	'Cardnuta'	musk thistle	Asteraceae	
5	*'Carex brevior'*	'Carebrev'	fescue sedge	Cyperaceae	Carbr
7	*'Carex laeviconica'*	'Carelaev'	smoothcone sedge	Cyperaceae	Carlv
7	*'Carex lanuginosa'*	'Carelanu'	woolly sedge	Cyperaceae	Carln
6	*'Carex sp.'*	'Carexxsp'	sedge	Cyperaceae	
6	*'Carex stipata'*	'Carestip'	sawbeak sedge	Cyperaceae	Carst
7	*'Carex tribuloides'*	'Caretrib'	bristlebract sedge	Cyperaceae	
6	*'Carex vulpinoidea'*	'Carevulp'	fox sedge	Cyperaceae	Carvu
3	*'Celtis occidentalis'*	'Celtocci'	hackberry	Ulmaceae	
5	*'Chenopodium album'*	'Chenalbu'	lamb's quarters	Chenopodiaceae	Cheal
4	*'Chenopodium desiccatum'*	'Chendess'	goosefoot	Chenopodiaceae	
5	*'Chenopodium sp.'*	'Chenopsp'	goosefoot	Chenopodiaceae	
5	*'Cirsium altissimum'*	'Cirsalti'	tall thistle	Asteraceae	
3	*'Cirsium arvense'*	'Cirsarve'	Canada thistle	Asteraceae	
3	*'Cirsium canescens'*	'Cirscane'	Platte thistle	Asteraceae	
5	*'Cirsium sp.'*	'Cirsiusp'	true thistle	Asteraceae	
4	*'Convolvulus arvensis'*	'Convarve'	field bindweed	Convolvulaceae	
5	*'Convolvulus sp.'*	'Convolsp'	field bindweed	Convolvulaceae	
3	*'Conyza canadensis'*	'Conycana'	horse-weed	Asteraceae	
4	*'Conyza ramosissima'*	'Conyramo'	spreading fleabane	Asteraceae	
6	*'Coreopsis tinctoria'*	'Coretinc'	plains coreopsis	Asteraceae	Corti
5	*'Cuscuta curta'*	'Cusccurt'	dodder	Cuscutaceae	
7	*'Cyperus acuminatus'*	'Cypeacum'	tapeleaf flatsedge	Cyperaceae	
7	*'Cyperus aristatus'*	'Cypearis'	bearded flatsedge	Cyperaceae	
7	*'Cyperus erythrorhizos'*	'Cypeeryt'	redrooted cyperus	Cyperaceae	
7	*'Cyperus esculentus'*	'Cypeescu'	yellow nutsedge	Cyperaceae	
3	*'Cyperus lupulinus'*	'Cypelupu'	houghton flatsedge	Cyperaceae	
5	*'Cyperus sp.'*	'Cyperusp'	umbrella sedge	Cyperaceae	
3	*'Dichanthelium oligosanthes'*	'Dicaolig'	Scribner dichanthelium	Poaceae	
6	*'Echinochloa crusgalli'*	'Echicrus'	barnyard grass	Poaceae	Echcr

HR	PLANT RECORD NAME	ABBREV. NAME	COMMON NAME	FAMILY	ABBREV.
6	*'Echinochloa muricata'*	'Echimuri'	rough barnyard grass	Poaceae	Echmu
6	*'Echinochloa sp.'*	'Echinosp'	barnyard grass	Poaceae	Echsp
7	*'Eleocharis acicularis'*	'Eleoacic'	needle spikesedge	Cyperaceae	
8	*'Eleocharis erthyropoda'*	'Eleoerth'	creeping spikesedge	Cyperaceae	
7	*'Eleocharis macrostachya'*	'Eleomacr'	spike rush	Cyperaceae	Elema
8	*'Eleocharis obtusa'*	'Eleoobtu'	blunt spikesedge	Cyperaceae	
8	*'Eleocharis smallii'*	'Eleosmal'	Small's spikesedge	Cyperaceae	Elesm
7	*'Eleocharis sp.'*	'Eleochsp'	spike rush	Cyperaceae	Elesp
4	*'Elymus canadensis'*	'Elymcana'	Canada wild rye	Poaceae	
5	*'Elymus virginicus'*	'Elymvirg'	Virginia wild rye	Poaceae	Elyvi
5	*'Erigeron strigosus'*	'Erigstri'	daisy fleabane	Asteraceae	
3	*'Euphorbia cyathophora'*	'Euphcyat'	fire-on-the-mountain	Euphorbiaceae	
3	*'Euphorbia dentata'*	'Euphdent'	toothed spurge	Euphorbiaceae	
3	*'Euphorbia glyptosperma'*	'Euphglyp'	ridge-seeded spurge	Euphorbiaceae	
3	*'Euphorbia maculata'*	'Euphmacu'	spotted spurge	Euphorbiaceae	
3	*'Euphorbia marginata'*	'Euphmarg'	snow-on-the-mountain	Euphorbiaceae	
5	*'Euphorbia nutans'*	'Euphnuta'	eyebane	Euphorbiaceae	
3	*'Fragaria virginiana'*	'Fragvirg'	wild strawberry	Rosaceae	
5	*'Fraxinus pennsylvanica'*	'Fraxpenn'	green ash	Oleaceae	
5	*'Galium aparine'*	'Galiapar'	catchweed bedstraw	Rubiaceae	
3	*'Gaura coccinea'*	'Gaurcocc'	scarlet gaura	Onagraceae	
4	*'Gleditsia triacanthos'*	'Gledtria'	honey locust	Caesalpiniaceae	
6	*'Glyceria sp.'*	'Glycersp'	mannagrass	Poaceae	
5	*'Glycine max'*	'Glycimax'	soybean (cultivated)	Fabaceae	Glyma
2	*'Grindelia squarrosa'*	'Grinsqua'	curly-top gumweed	Asteraceae	
5	*'Hedeoma hispidum'*	'Hedehisp'	rough false pennyroyal	Lamiaceae	
4	*'Helianthus annuus'*	'Heliannu'	common sunflower	Asteraceae	
4	*'Helianthus petiolaris'*	'Helipeto'	plains sunflower	Asteraceae	
4	*'Helianthus sp.'*	'Heliansp'	sunflower	Asteraceae	Helsp
9	*'Heteranthera limosa'*	'Hetelimo'	long-leaf mud plantain	Pontederiaceae	Hetli
9	*'Heteranthera peduncularis'*	'Hetepedu'	mud plantain	Pontederiaceae	
9	*'Heteranthera sp'*	'Heterasp'	mud plantain	Pontederiaceae	
5	*'Hordeum jubatum'*	'Hordjuba'	foxtail barley	Poaceae	Horju
3	*'Hordeum pusillum'*	'Hordpusi'	little barley	Poaceae	
7	*'Juncus dudleyi'*	'Juncdudl'	Dudley rush	Juncaceae	
6	*'Juncus interior'*	'Juncinte'	inland rush	Juncaceae	
7	*'Juncus sp.'*	'Juncussp'	rush	Juncaceae	
3	*'Kochia scoparia'*	'Kochscop'	kochia	Chenopodiaceae	
3	*'Kuhnia eupatorioides'*	'Kuhneupa'	false boneset	Asteraceae	
5	*'Lactuca serriola'*	'Lactserr'	prickly lettuce	Asteraceae	
5	*'Lactuca sp.'*	'Lactucsp'	lettuce	Asteraceae	

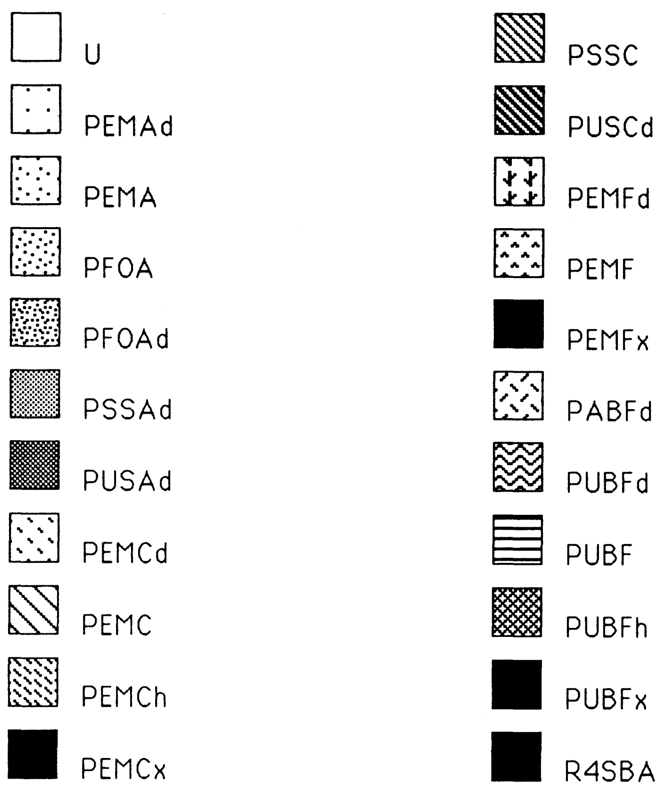
HR	PLANT RECORD NAME	ABBREV. NAME	COMMON NAME	FAMILY	ABBREV.
5	'Lamiaceae I'	'Lamiacea'	Mint family	-	
7	*'Leersia oryzoides'*	'Leeroryz'	rice cutgrass	Poaceae	Leeor
9	*'Lemna minor'*	'Lemnmino'	common duckweed	Lemnaceae	Lemmi
9	*'Lemna sp.'*	'Lemnaxsp'	duckweed	Lemnaceae	Lemsp
3	*'Lepidium virginicum'*	'Lepivirg'	peppergrass	Brassicaceae	
6	*'Leptochloa fascicularis'*	'Leptfasc'	bearded sprangletop	Poaceae	Lepfa
5	'Lichen'	'Lichenxx'	lichen	-	
6	*'Lindernia dubia'*	'Linddubi'	yellowseed false pimpernel	Scrophulariaceae	
3	*'Linum rigidum'*	'Linurigi'	stiffstem flax	Linaceae	
6	*'Lippia cuneifolia'*	'Lippcune'	wedgeleaf fog-fruit	Verbenaceae	
3	*'Lithospermum incisum'*	'Lithinci'	narrow-leaved puccoon	Boraginaceae	
5	'Liverwort'	'Liverwor'	liverwort	-	
4	*'Lotus purshianus'*	'Lotupurs'	prairie trefoil	Fabaceae	
8	*'Ludwigia palustris'*	'Ludwpalu'	marsh seedbox	Onagraceae	
7	*'Lycopus americanus'*	'Lycoamer'	American bugleweed	Lamiaceae	
8	*'Marsilea vestita'*	'Marsvest'	western water clover	Marsileaceae	Marve
4	*'Medicago sativa'*	'Medisati'	alfalfa	Fabaceae	
3	*'Melilotus alba'*	'Melialba'	white sweet clover	Fabaceae	
3	*'Melilotus officinalis'*	'Melioffi'	yellow sweet clover	Fabaceae	Melof
4	*'Mirabilis linearis'*	'Miraline'	narrowleaf four-o'clock	Nyctaginaceae	
4	*'Mirabilis nyctaginea'*	'Miranyct'	wild four-o'clock	Nyctaginaceae	
4	*'Mollugo verticillata'*	'Mollvert'	carpetweed	Molluginaceae	
4	*'Morus alba'*	'Morualba'	white mulberry	Moraceae	
5	*'Muhlenbergia mexicana'*	'Muhlmexi'	wirestem muhly	Poaceae	
5	*'Muhlenbergia racemosa'*	'Muhlrace'	marsh muhly	Poaceae	
5	*'Muhlenbergia sp.'*	'Muhlensp'	muhly	Poaceae	
7	*'Myosurus minimus'*	'Myosmini'	mouse-tail	Ranunculaceae	
4	*'Nepeta cataria'*	'Nepecata'	catnip	Lamiaceae	
4	*'Oxalis stricta'*	'Oxalstri'	yellow wood sorrel	Oxalidaceae	
5	*'Panicum capillare'*	'Panicapi'	common witchgrass	Poaceae	
5	*'Panicum dichotomiflorum'*	'Panidich'	fall panicum	Poaceae	Pandi
5	*'Panicum virgatum'*	'Panivirg'	switchgrass	Poaceae	Panvi
4	*'Parietaria pensylvanica'*	'Paripens'	Pennsylvania pellitory	Urticaceae	
7	*'Phalaris arundinacea'*	'Phalarun'	reed canary grass	Poaceae	Phaar
5	*'Phleum pratense'*	'Phleprat'	timothy	Poaceae	
5	*'Physalis longifolia'*	'Physlong'	common ground cherry	Solanaceae	
5	*'Physalis virginiana'*	'Physvirg'	Virginia ground cherry	Solanaceae	
3	*'Poa compressa'*	'Poacompr'	Canada bluegrass	Poaceae	Poaco
4	*'Poa pratensis'*	'Poaprate'	Kentucky bluegrass	Poaceae	Poapr
5	'Poaceae'	'Poaceaex'	Grass family	-	
4	*'Polygala alba'*	'Polyalba'	white milkwort	Polygalaceae	

HR	PLANT RECORD NAME	ABBREV.NAME	COMMON NAME	FAMILY	ABBREV.
8	*'Polygonum amphibium'*	'Polyamph'	water smartweed	Polygonaceae	Polam
7	*'Polygonum bicorne'*	'Polybico'	pink smartweed	Polygonaceae	Polbi
8	*'Polygonum hydropiper'*	'Polyhydr'	water pepper	Polygonaceae	Polhy
7	*'Polygonum lapathifolium'*	'Polylapa'	pale smartweed	Polygonaceae	Polla
6	*'Polygonum pensylvanicum'*	'Polypens'	Pennsylvania smartweed	Polygonaceae	
7	*'Polygonum persicaria'*	'Polypers'	lady's thumb	Polygonaceae	
8	*'Polygonum punctatum'*	'Polypunc'	water smartweed	Polygonaceae	
5	*'Polygonum ramosissimum'*	'Polyramo'	knotweed	Polygonaceae	
7	*'Polygonum sp.'*	'Polygosp'	smartweed	Polygonaceae	Polsp
7	*'Polygonum spp.'*	'Polygspp'	smartweed	Polygonaceae	Pospp
5	*'Populus deltoides'*	'Popudelt'	cottonwood	Salicaceae	Popde
4	*'Portulaca oleracea'*	'Portoler'	common purslane	Portulacaceae	
9	*'Potamogeton gramineus'*	'Potagram'	variable pondweed	Potamogetonaceae	
9	*'Potamogeton nodosus'*	'Potanodo'	longleaf pondweed	Potamogetonaceae	
6	*'Potentilla norvegica'*	'Potenorv'	Norwegian cinquefoil	Rosaceae	
3	*'Prunus americana'*	'Prunamer'	wild plum	Rosaceae	
3	*'Psoralea argophylla'*	'Psorargo'	silver-leaf scurf pea	Fabaceae	
3	*'Psoralea tenuiflora'*	'Psortenu'	wild alfalfa	Fabaceae	
3	*'Ratibida columnifera'*	'Raticolu'	prairie coneflower	Asteraceae	
5	*'Rhus sp.'*	'Rhusxxsp'	sumac	Anacardicaceae	
9	*'Riccia fluitans'*	'Riccflui'	liverwort	Ricciaceae	
9	*'Riccia sp.'*	'Ricciasp'	liverwort	Ricciaceae	
9	*'Ricciocarpus sp.'*	'Ricciosp'	liverwort	Ricciaceae	
7	*'Rorippa palustris'*	'Roripalu'	bog yellow cress	Brassicaceae	
7	*'Rorippa sessiliflora'*	'Rorisess'	yellow cress	Brassicaceae	
6	*'Rorippa sinuata'*	'Rorisinu'	spreading yellow cress	Brassicaceae	
6	*'Rorippa sp.'*	'Rorippsp'	yellow cress	Brassicaceae	
3	*'Rosa arkansana'*	'Rosaarka'	prairie wild rose	Rosaceae	
6	*'Rumex altissimus'*	'Rumealti'	pale dock	Polygonaceae	
5	*'Rumex crispus'*	'Rumecris'	curly dock	Polygonaceae	Rumcr
9	*'Sagittaria latifolia'*	'Sagilati'	arrowhead	Alismataceae	Sagla
9	*'Sagittaria rigida'*	'Sagirigi'	bur arrowhead	Alismataceae	
9	*'Sagittaria sp.'*	'Sagittsp'	arrowhead	Alismataceae	Sagsp
9	*'Scirpus acutus'*	'Sciracut'	hard-stem bulrush	Cyperaceae	Sciac
9	*'Scirpus fluviatilis'*	'Scirfluv'	river bulrush	Cyperaceae	Scifl
9	*'Scirpus pungens'*	'Scirpung'	three-square	Cyperaceae	
9	*'Scirpus spp.'*	'Scirpspp'	bulrush	Cyperaceae	Scspp
9	*'Scirpus validus'*	'Scirvali'	soft-stem bulrush	Cyperaceae	
4	*'Setaria glauca'*	'Setaglau'	yellow foxtail	Poaceae	
5	*'Setaria sp.'*	'Setarisp'	foxtail	Poaceae	
4	*'Silphium laciniatum'*	'Silplaci'	compass plant	Asteraceae	

HR	PLANT RECORD NAME	ABBREV. NAME	COMMON NAME	FAMILY	ABBREV.
4	*'Solanum interius'*	'Solainte'	plains black nightshade	Solanaceae	
4	*'Solanum rostratum'*	'Solarost'	buffalo bur	Solanaceae	
4	*'Solidago canadensis'*	'Solicana'	Canada goldenrod	Asteraceae	
3	*'Solidago missouriensis'*	'Solimiss'	prairie goldenrod	Asteraceae	
2	*'Solidago rigida'*	'Solirigi'	rigid goldenrod	Asteraceae	
5	*'Solidago sp.'*	'Solidasp'	goldenrod	Asteraceae	
3	*'Sorghastrum nutans'*	'Sorgnuta'	Indian grass	Poaceae	Sornu
5	*'Sorghum spp.'*	'Sorghspp'	sorghum (cultivated)	Poaceae	Sospp
9	*'Sparganium eurycarpum'*	'Spareury'	bur-reed	Poaceae	Spaeu
7	*'Spartina pectinata'*	'Sparpect'	prairie cordgrass	Poaceae	Spape
2	*'Sphaeralcea coccinea'*	'Sphacocc'	red false mallow	Malvaceae	
7	*'Sphenopholis obtusata'*	'Spheobtu'	wedgegrass	Poaceae	
9	*'Spirodela polyrrhiza'*	'Spirpoly'	greater duckweed	Lemnaceae	Spipo
3	*'Sporobolus asper'*	'Sporaspe'	rough dropseed	Poaceae	
6	*'Stachys palustris'*	'Stacpalu'	marsh betony	Lamiaceae	
4	*'Strophostyles leiosperma'*	'Stroleio'	slick-seed bean	Fabaceae	
4	*'Taraxacum officinale'*	'Taraoffi'	common dandelion	Asteraceae	
6	*'Teucrium canadense'*	'Teuccana'	American germander	Lamiaceae	
4	*'Thlaspi arvense'*	'Thlaarve'	field pennycress	Brassicaceae	
3	*'Tragopogon dubius'*	'Tragdubi'	goat's beard	Asteraceae	
5	*'Tragopogon sp.'*	'Tragopsp'	goat's beard	Asteraceae	
4	*'Trifolium pratense'*	'Trifprat'	red clover	Fabaceae	
4	*'Trifolium repens'*	'Trifrepe'	white clover	Fabaceae	
3	*'Triodanis perfoliata'*	'Trioperf'	Venus' looking glass	Campanulaceae	
5	*'Triticum aestivum'*	'Tritaest'	wheat (cultivated)	Poaceae	Triae
9	*'Typha angustifolia'*	'Typhangu'	narrow-leaved cattail	Typhaceae	
9	*'Typha glauca'*	'Typhglau'	hybrid cattail	Typhaceae	Typgl
9	*'Typha latifolia'*	'Typhlati'	broad-leaved cattail	Typhaceae	Typla
9	*'Typha sp.'*	'Typhaxsp'	cattail	Typhaceae	
3	*'Ulmus pumila'*	'Ulmupumi'	Siberian elm	Ulmaceae	
9	*'Utricularia vulgaris'*	'Utrivulg'	common bladderwort	Lentibulariaceae	Utrvu
3	*'Verbena bracteata'*	'Verbbrac'	prostrate vervain	Verbenaceae	
5	*'Verbena hastata'*	'Verbhast'	blue vervain	Verbenaceae	
5	*'Verbena sp.'*	'Verbensp'	vervain	Verbenaceae	
2	*'Verbena stricta'*	'Verbstri'	hoary vervain	Verbenaceae	
4	*'Vernonia baldwinii'*	'Vernbald'	western ironweed	Asteraceae	
6	*'Vernonia fasciculata'*	'Vernfasc'	ironweed	Asteraceae	
7	*'Veronica peregrina'*	'Veropere'	purslane speedwell	Scrophulariaceae	
4	*'Vicia americana'*	'Viciamer'	American vetch	Fabaceae	
9	*'Wolffia columbiana'*	'Wolfcolu'	watermeal	Lemnaceae	
5	*'Xanthium strumarium'*	'Xantstru'	cocklebur	Asteraceae	

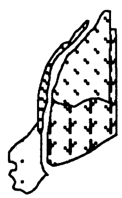
HR	**PLANT RECORD NAME**	**ABBREV. NAME**	**COMMON NAME**	**FAMILY**	**ABBREV.**
5	*'Zea mays'*	'Zeaxmays'	corn (cultivated)	Poaceae	Zeama

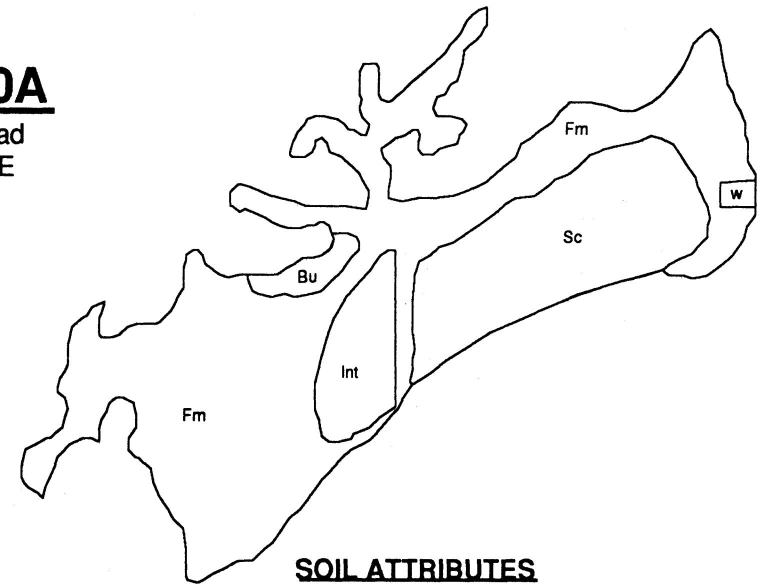
Appendix C. Wetland and soil maps for individual study sites. Classification legend for wetland attributes is presented below. Descriptions of the soil mapping units and wetland classification can be found in Tables 3 and 4, respectively. The maps are presented at a scale of 1:24000. Linear features and attributes with an "x" modifier appear in black.



BUTLER 10A

Rising City, Ne. Quad
Sec. 36, T14N, R1E





WETLAND ATTRIBUTES

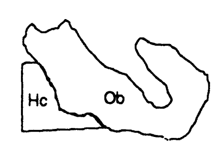
PUBFd =	2.0 acres
PEMAd =	3.8 acres
PEMCd =	8.6 acres
PEMFd =	9.9 acres

SOIL ATTRIBUTES

Bu =	7.8 acres
Fm =	223.7 acres
Sc =	79.4 acres
w =	2.2 acres
Int =	24.2 acres

BUTLER 18

David City East, Ne. Quad
Sec. 21, T15N, R3E



WETLAND ATTRIBUTES

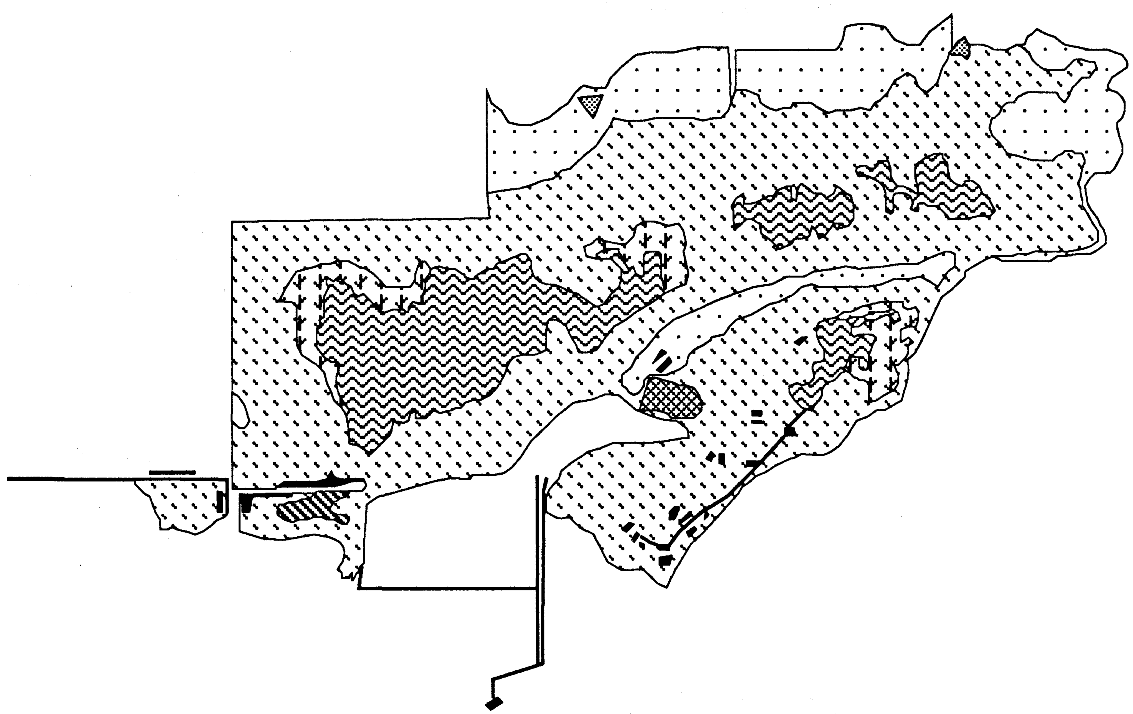
PEMA =	3.3 acres

SOIL ATTRIBUTES

Hc =	7.5 acres
Ob =	26.8 acres

CLAY 2

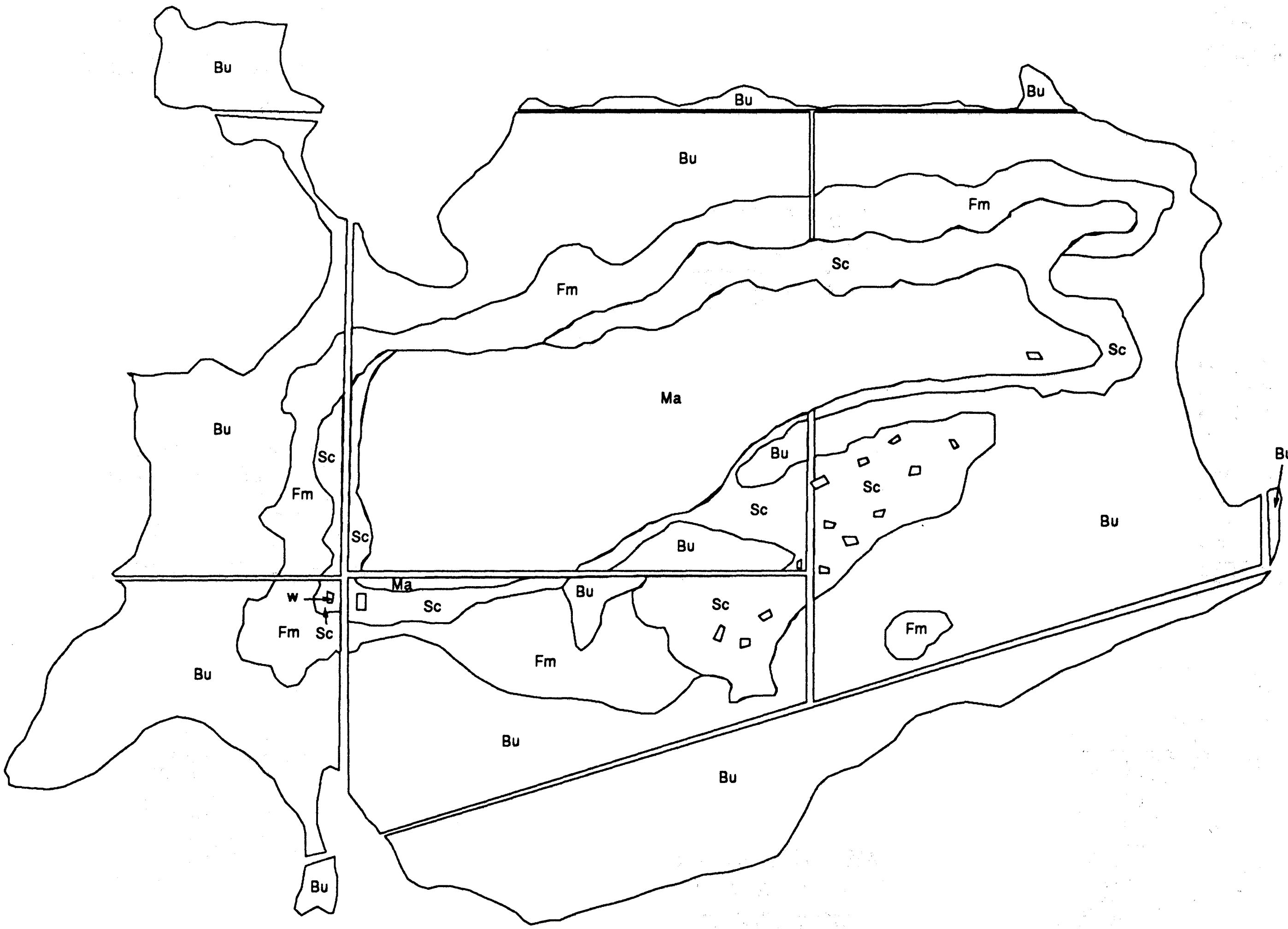
Inland, Ne. Quad
Sec. 35 & 36, T8N, R8W
Sec. 31, T8N, R7W
Sec. 1 & 2, T7N, R8W
Sec. 6, T7N, R7W



WETLAND ATTRIBUTES

PUBFd =	113.2 acres
PUBFx =	8.1 acres
PUSCd =	4.0 acres
PEMAd =	127.8 acres
PEMCd =	458.5 acres
PEMCx =	2.4 acres
PEMFd =	34.4 acres
PUBFh =	4.7 acres
U =	1.2 acres
PSSAd =	1.6 acres

CLAY 2
(Continued)

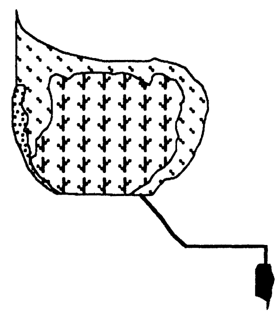


SOIL ATTRIBUTES

Bu	=	1159.8 acres
Fm	=	238.8 acres
Sc	=	256.7 acres
Ma	=	351.2 acres
w	=	5.0 acres

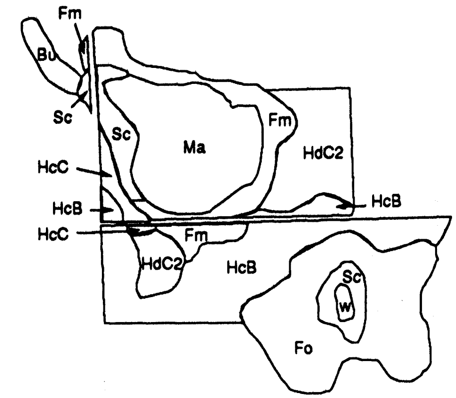
CLAY 9

Edgar NW, Ne. Quad
Sec. 15, T6N, R6W



WETLAND ATTRIBUTES

PUBFx =	1.6 acres
PEMCd =	20.0 acres
PEMCx =	0.8 acres
PEMFd =	37.7 acres
PFOAd =	2.8 acres

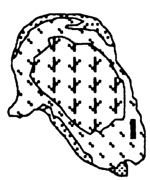


SOIL ATTRIBUTES

Bu =	5.0 acres
Fm =	23.7 acres
Sc =	13.6 acres
Ma =	37.2 acres
w =	1.5 acres
Fo =	45.6 acres
HcC =	4.2 acres
HdC2 =	26.4 acres
HcB =	47.1 acres

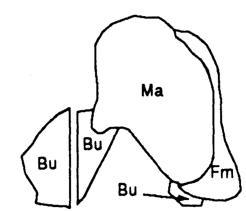
CLAY 11

Fairfield, Ne. Quad
Sec. 16, T6N, R6W



WETLAND ATTRIBUTES

PUBFx =	0.3 acres
PEMCd =	14.8 acres
PEMFd =	14.8 acres
PFOAd =	4.8 acres
PSSAd =	0.5 acres

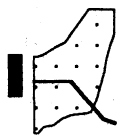


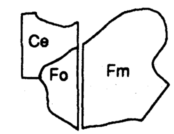
SOIL ATTRIBUTES

Bu =	14.9 acres
Fm =	7.7 acres
Ma =	36.6 acres

CLAY 13

Edgar NW, Ne. Quad
Sec. 15 & 16, T6N,
R6W





WETLAND ATTRIBUTES

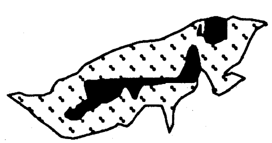
PUBFx = 1.7 acres
PEMAd = 13.8 acres
PEMCx = 0.5 acres

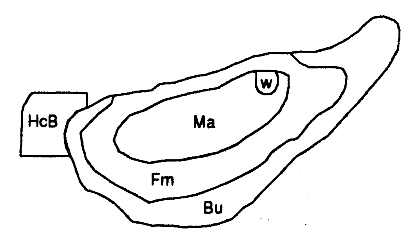
SOIL ATTRIBUTES

Fm = 20.9 acres
Fo = 5.1 acres
Ce = 6.9 acres

CLAY 24

Fairfield, Ne. Quad
Sec. 30, T6N, R6W





WETLAND ATTRIBUTES

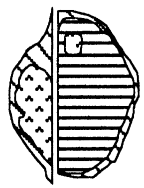
PUBFx = 7.4 acres
PEMCd = 27.6 acres

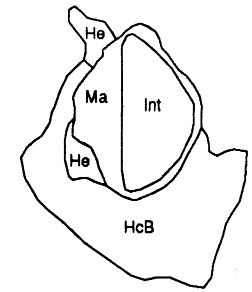
SOIL ATTRIBUTES

Bu = 31.7 acres
Fm = 36.0 acres
Ma = 24.1 acres
w = 1.3 acres
HcB = 8.5 acres

CLAY 33

Edgar, Ne. Quad
Secs. 25 & 26, T6N, R6W





WETLAND ATTRIBUTES

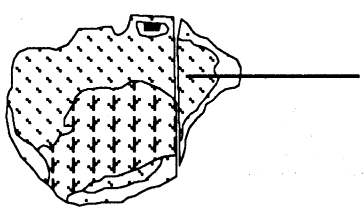
PUBF = 20.5 acres
PEMC = 7.7 acres
PEMF = 7.4 acres

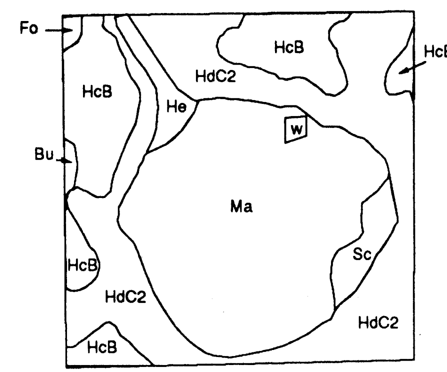
SOIL ATTRIBUTES

Ma = 17.3 acres
Int = 21.7 acres
HcB = 50.2 acres
He = 7.1 acres

CLAY 35

Edgar NW, Ne. Quad
Sec. 31, T6N, R5W
Sec. 36, T6N, R6W





WETLAND ATTRIBUTES

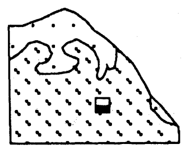
PUBFx = 0.5 acres
PEMAd = 11.1 acres
PEMCd = 38.1 acres
PEMFd = 27.2 acres
U = 0.7 acres
PEMFx = 1.1 acres

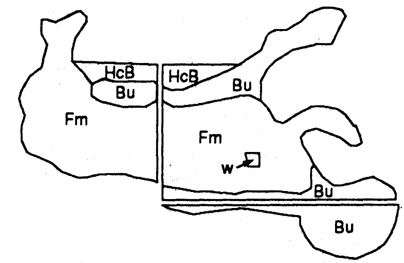
SOIL ATTRIBUTES

Bu = 1.5 acres
Sc = 7.3 acres
Ma = 87.0 acres
w = 1.1 acres
Fo = 1.0 acres
He = 6.1 acres
HdC2 = 80.3 acres
HcB = 42.1 acres

CLAY 52

Edgar NW, Ne. Quad
Sec. 7, T5N, R5W





WETLAND ATTRIBUTES

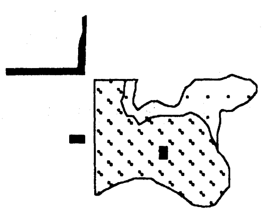
PUBFx =	0.2 acres
PEMAd =	10.0 acres
PEMCd =	27.0 acres
U =	0.4 acres

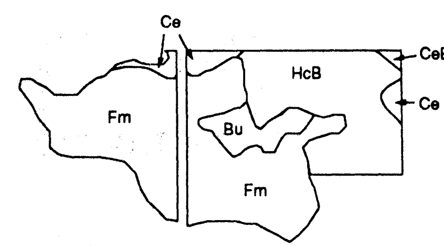
SOIL ATTRIBUTES

Bu =	37.1 acres
Fm =	65.2 acres
w =	0.5 acres
HcB =	7.4 acres

CLAY 53

Edgar NW, Ne. Quad
Sec. 7, T5N, R5W





WETLAND ATTRIBUTES

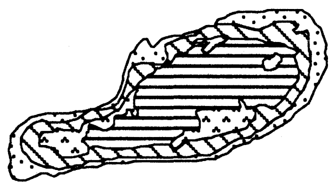
PUBFx =	2.6 acres
PEMAd =	9.5 acres
PEMCd =	25.0 acres

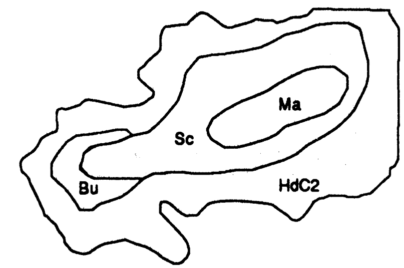
SOIL ATTRIBUTES

Bu =	7.7 acres
Fm =	66.1 acres
Ce =	6.2 acres
CeB =	0.9 acres
HcB =	35.7 acres

CLAY 94

Edgar NW, Ne. Quad
Sec. 29, T6N, R5W





WETLAND ATTRIBUTES

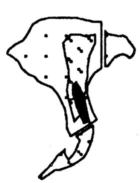
PUBF	=	32.9 acres
PEMA	=	17.6 acres
PEMC	=	22.0 acres
PEMF	=	12.0 acres

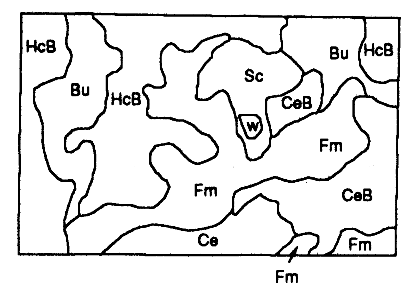
SOIL ATTRIBUTES

Bu	=	9.1 acres
Sc	=	48.3 acres
Ma	=	16.0 acres
HdC2	=	86.5 acres

CLAY 152

Harvard, Ne. Quad
Sec. 29, T7N, R6W





WETLAND ATTRIBUTES

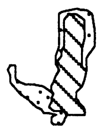
PUBFx	=	0.9 acres
PEMAd	=	12.2 acres
PEMCd	=	5.2 acres
U	=	0.4 acres

SOIL ATTRIBUTES

Bu	=	36.7 acres
Fm	=	57.3 acres
Sc	=	15.4 acres
w	=	1.1 acres
Ce	=	16.5 acres
CeB	=	32.9 acres
HcB	=	68.8 acres

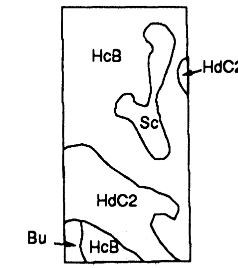
CLAY 216

Edgar NW, Ne. Quad
Sec. 25, T6N, R6W



WETLAND ATTRIBUTES

PEMA = 3.6 acres
PEMC = 5.0 acres

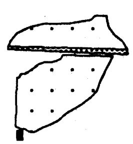


SOIL ATTRIBUTES

Bu = 2.1 acres
Sc = 8.5 acres
HcB = 50.5 acres
HdC2 = 19.1 acres

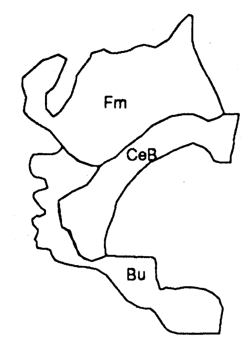
CLAY 227

Harvard, Ne. Quad
Sec. 28 & 33, T7N, R6W



WETLAND ATTRIBUTES

PUBFx = 0.2 acres
PEMAd = 20.0 acres
PSSAd = 1.4 acres

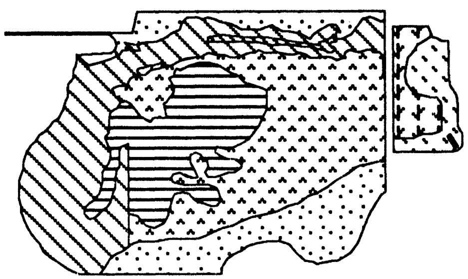


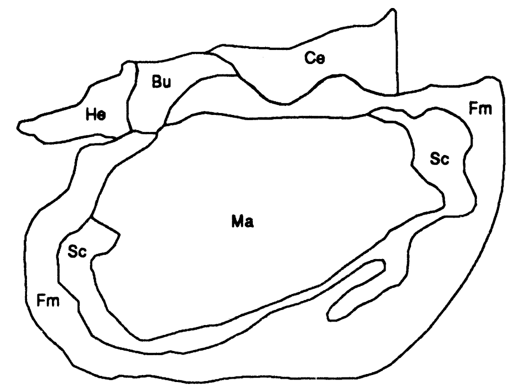
SOIL ATTRIBUTES

Bu = 23.9 acres
Fm = 37.4 acres
CeB = 20.8 acres

FILLMORE 13

Shickley, Ne. Quad
Sec. 25 & 26, T6N, R4W





WETLAND ATTRIBUTES

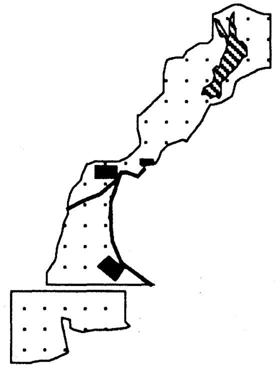
PUBF	=	37.0 acres
PUBFx	=	0.2 acres
PEMA	=	40.0 acres
PEMC	=	52.9 acres
PEMCd	=	9.5 acres
PEMCx	=	0.6 acres
PEMF	=	62.5 acres
PEMFd	=	9.1 acres
PFOA	=	0.7 acres
PSSC	=	2.7 acres

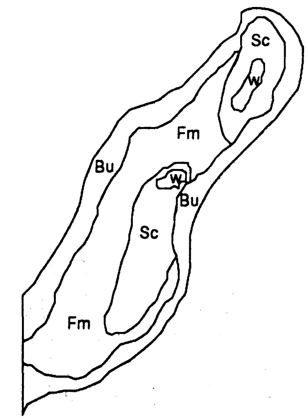
SOIL ATTRIBUTES

Bu	=	11.4 acres
Fm	=	111.0 acres
Sc	=	41.2 acres
Ma	=	137.0 acres
Ce	=	23.6 acres
He	=	11.7 acres

FILLMORE 19

Ong, Ne. Quad
Sec. 30&31 T6N, R4W





WETLAND ATTRIBUTES

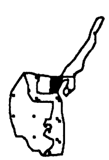
PUBFX	=	2.1 acres
PUSCd	=	3.5 acres
PEMAd	=	53.4 acres
PEMCx	=	1.0 acres

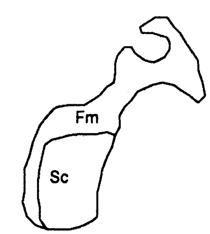
SOIL ATTRIBUTES

Bu	=	44.4 acres
Fm	=	49.8 acres
Sc	=	29.8 acres
w	=	3.6 acres

FILLMORE 22

Shickley, Ne. Quad
Sec. 23, T6N, R4W





WETLAND ATTRIBUTES

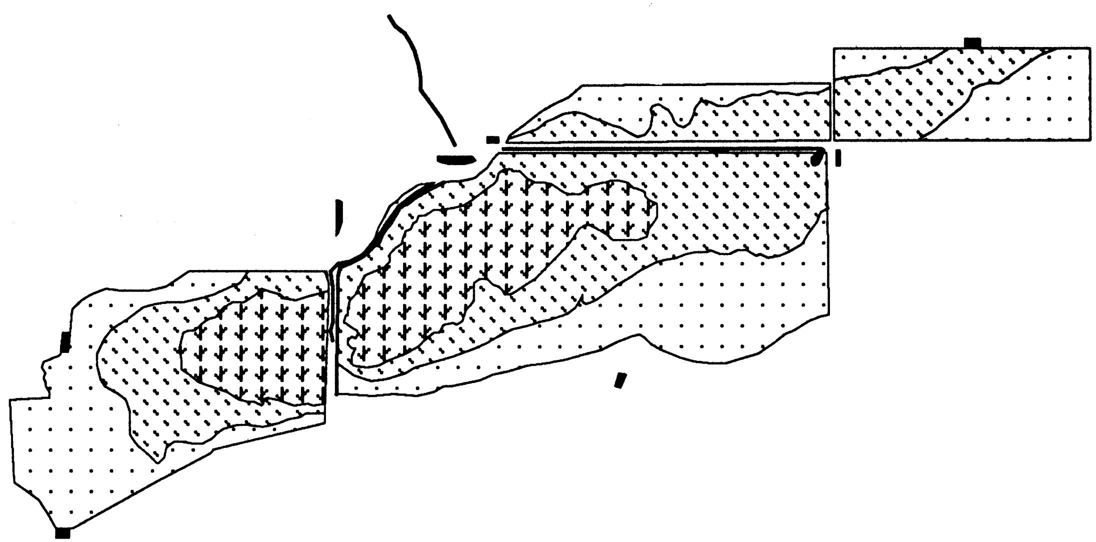
PUBFx	=	0.4 acres
PEMAd	=	6.5 acres
PEMCd	=	3.3 acres

SOIL ATTRIBUTES

Fm	=	15.2 acres
Sc	=	11.1 acres

FILLMORE 46

Geneva SW, Ne. Quad
Sec. 32 & 33, T8N, R3W
Sec. 4, 5, & 6, T7N, R3W

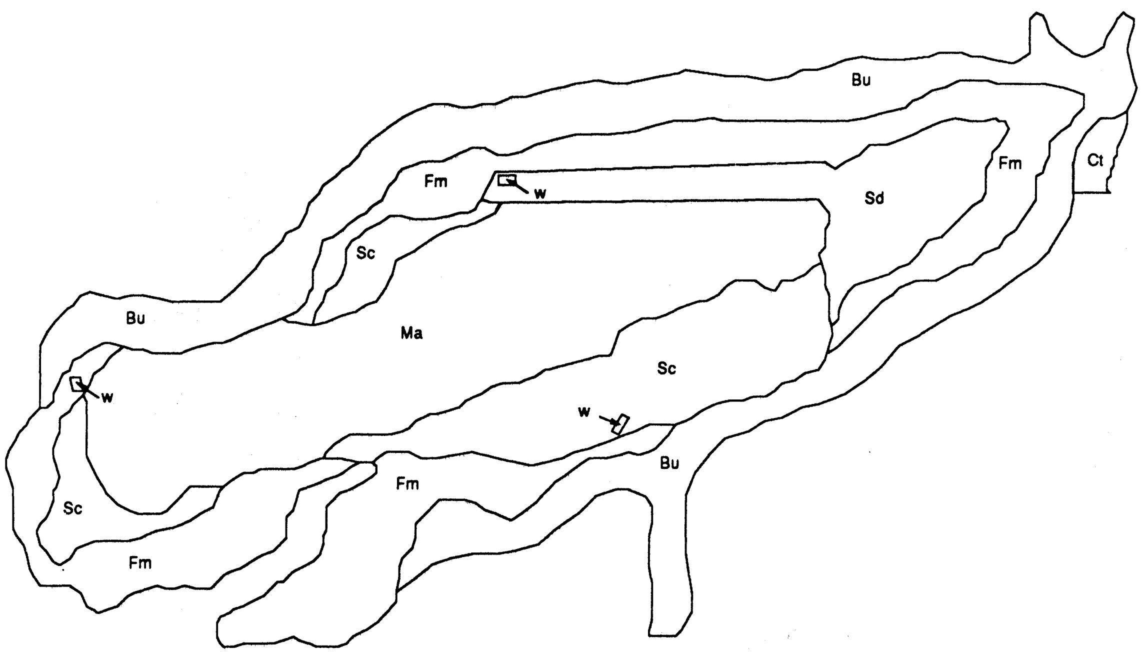


WETLAND ATTRIBUTES

PUBFx =	6.0 acres
PEMAd =	183.9 acres
PEMCd =	195.6 acres
PEMCx =	3.8 acres
PEMFd =	101.4 acres

FILLMORE 46

(Continued)

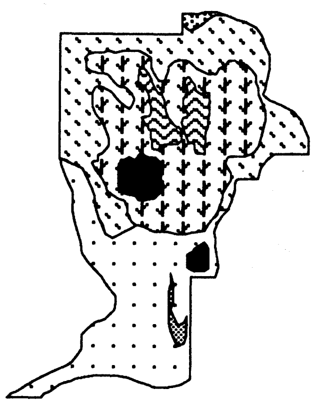


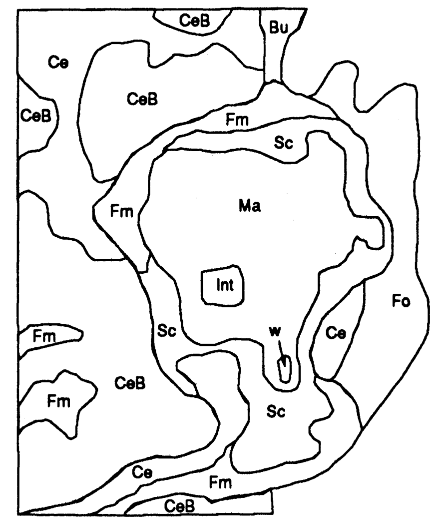
SOIL ATTRIBUTES

Bu	=	235.6 acres
Fm	=	234.9 acres
Sc	=	134.8 acres
Ma	=	252.8 acres
w	=	1.5 acres
Sd	=	76.7 acres
Ct	=	7.0 acres

FILLMORE 84

Sutton, Ne. Quad
Sec. 10, T7N, R4W





WETLAND ATTRIBUTES

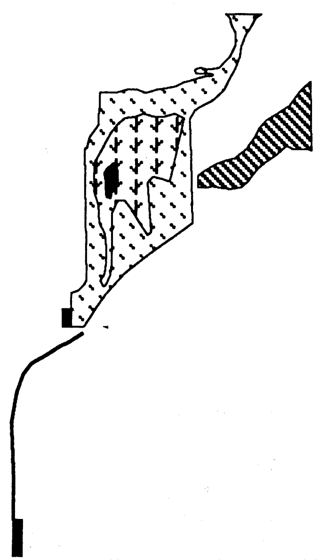
PUBFd	=	8.2 acres
PUBFx	=	6.3 acres
PEMAd	=	45.5 acres
PEMCd	=	42.4 acres
PEMFd	=	47.8 acres
PFOAd	=	1.4 acres
PSSAd	=	1.5 acres

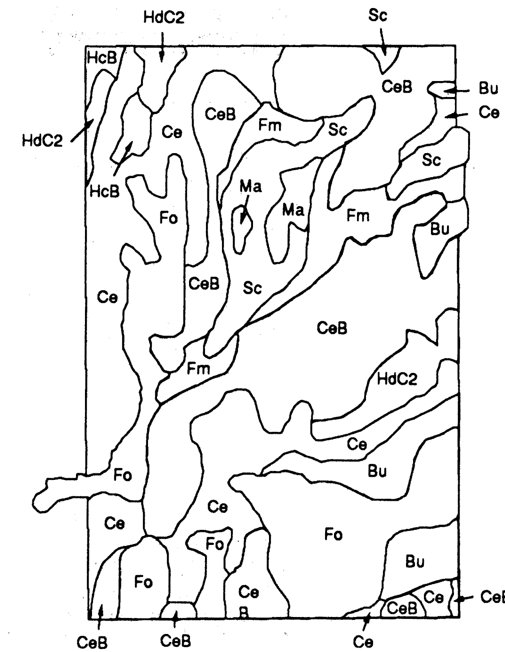
SOIL ATTRIBUTES

Bu	=	5.0 acres
Fm	=	51.7 acres
Sc	=	51.6 acres
Ma	=	85.3 acres
w	=	0.9 acres
Int	=	4.1 acres
Fo	=	45.8 acres
Ce	=	79.2 acres
CeB	=	130.6 acres

FILLMORE 86

Sutton, Ne. Quad
Sec. 5, T7N, R4W





WETLAND ATTRIBUTES

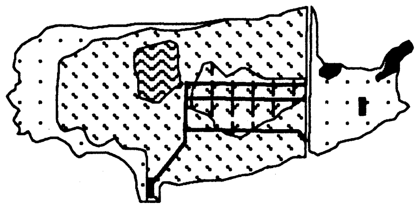
PUBFx	=	2.5 acres
PUSCd	=	10.8 acres
PEMCd	=	34.6 acres
PEMCx	=	0.5 acres
PEMFd	=	17.4 acres

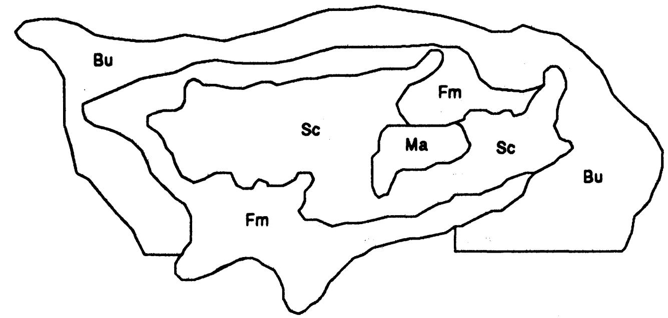
SOIL ATTRIBUTES

Bu	=	35.1 acres
Fm	=	34.4 acres
Sc	=	37.6 acres
Ma	=	8.8 acres
Fo	=	100.3 acres
Ce	=	117.3 acres
CeB	=	160.3 acres
HdC2	=	25.1 acres
HcB	=	7.5 acres

FILLMORE 91

Shickley, Ne. Quad
Sec. 21 & 22, T5N, R3W





WETLAND ATTRIBUTES

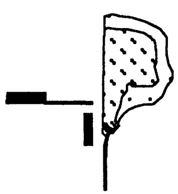
PUBFd =	5.5 acres
PUBFx =	3.2 acres
PEMAd =	33.9 acres
PEMCd =	60.7 acres
PEMFd =	11.8 acres
PEMFx =	2.7 acres

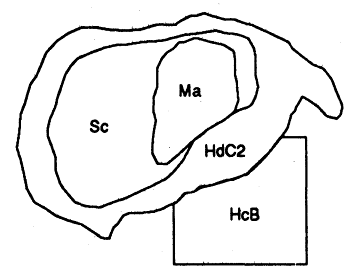
SOIL ATTRIBUTES

Bu =	123.3 acres
Fm =	87.6 acres
Sc =	91.5 acres
Ma =	10.7 acres

FILLMORE 112

Ong, Ne. Quad
Sec. 18, T5N, R4W





WETLAND ATTRIBUTES

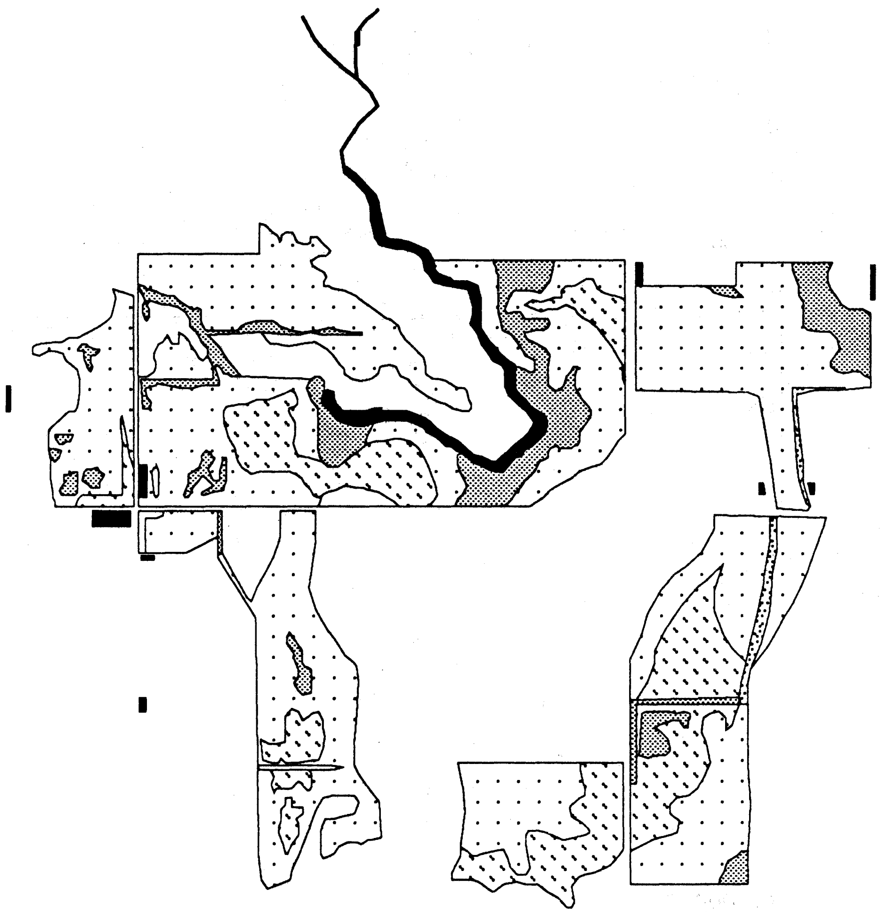
PUBFx =	2.1 acres
PUSCd =	0.4 acres
PEMAd =	5.9 acres
PEMCd =	8.6 acres
PEMCx =	0.4 acres

SOIL ATTRIBUTES

Sc =	42.4 acres
Ma =	18.9 acres
HdC2 =	51.9 acres
HcB =	31.6 acres

FRANKLIN 1

Macon, Ne. Quad
Sec. 25 & 26, T3N, R15W
Sec. 35 & 36, T3N, R15W
Sec. 30 & 31, T3N, R14W



WETLAND ATTRIBUTES

PUBFx =	5.3 acres
PEMAd =	392.8 acres
PEMCd =	111.7 acres
PEMCx =	15.7 acres
PFOAd =	7.3 acres
U =	12.6 acres
PSSAd =	78.9 acres

FRANKLIN 1

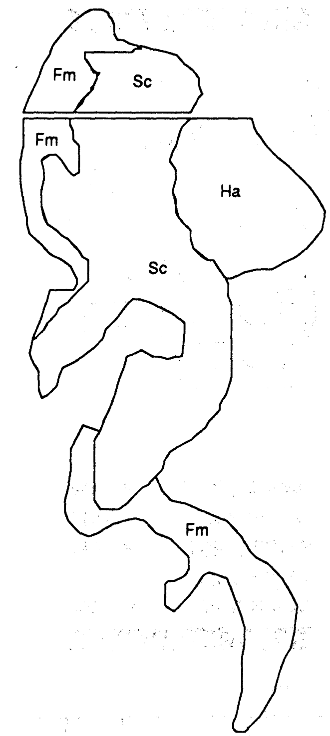
(Continued)

SOIL ATTRIBUTES

Fm	=	494.2 acres
Sc	=	411.2 acres
Int	=	292.8 acres
De	=	135.0 acres
Hh	=	51.8 acres
HhB	=	300.0 acres

FRANKLIN 4

Hildreth, Ne. Quad
Sec. 5, T3N, R15W



WETLAND ATTRIBUTES

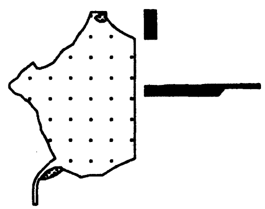
PUBFx = 2.9 acres
PEMCd = 52.1 acres

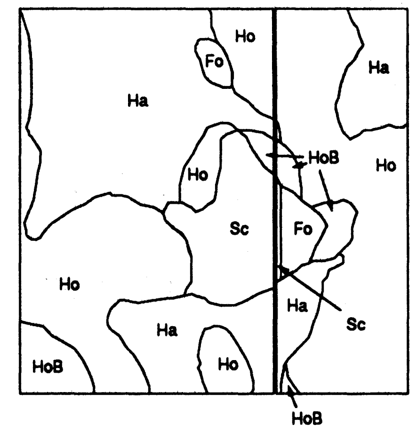
SOIL ATTRIBUTES

Fm = 72.1 acres
Sc = 126.7 acres
Ha = 43.9 acres

GOSPER 4

Oxford NW, Ne. Quad
Sec. 14 & 15, T6N, R21W





WETLAND ATTRIBUTES

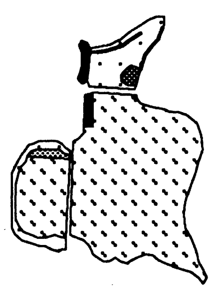
PUBFx	=	4.2 acres
PEMAd	=	32.5 acres
PSSAd	=	0.7 acres

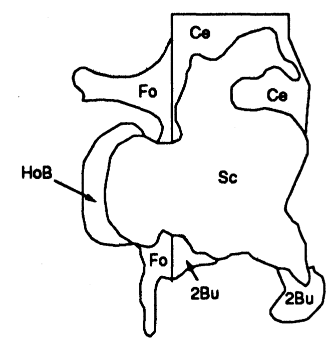
SOIL ATTRIBUTES

Sc	=	28.6 acres
Fo	=	10.1 acres
Ho	=	158.8 acres
HoB	=	18.2 acres
Ha	=	136.4 acres

GOSPER 8

Bertrand, Ne. Quad
Sec 19, T7N, R20W
Sec. 24, T7N, R21W





WETLAND ATTRIBUTES

PUBFx	=	1.7 acres
PUSAd	=	0.8 acres
PEMAd	=	9.4 acres
PEMCd	=	53.2 acres
PEMCx	=	0.5 acres
PSSAd	=	1.1 acres

SOIL ATTRIBUTES

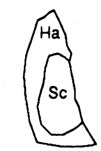
Sc	=	78.5 acres
Fo	=	16.0 acres
Ce	=	21.3 acres
HoB	=	8.9 acres
2Bu	=	8.5 acres

GOSPER 15

Elwood NW, Ne. Quad
Sec. 6, T8N, R23W

WETLAND ATTRIBUTES

PEMCd =	3.3 acres
PEMCx =	0.2 acres

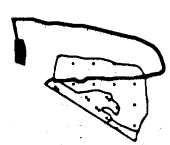


SOIL ATTRIBUTES

Sc =	5.6 acres
Ha =	8.0 acres

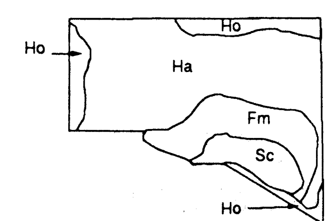
GOSPER 17

Elwood SW, Ne. Quad
Sec. 35, T8N, R23W



WETLAND ATTRIBUTES

PUBFx =	0.7 acres
PEMAd =	9.0 acres
PEMCd =	4.0 acres
PEMCx =	1.8 acres



SOIL ATTRIBUTES

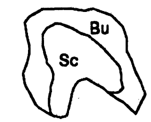
Fm =	18.9 acres
Sc =	10.0 acres
Ho =	15.3 acres
Ha =	58.1 acres

HAMILTON 9

Giltner, Ne. Quad
Sec. 33, T10N, R8W

WETLAND ATTRIBUTES

PEMCd =	8.8 acres
PEMFx =	0.9 acres

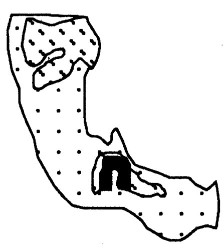


SOIL ATTRIBUTES

Bu =	12.7 acres
Sc =	10.6 acres

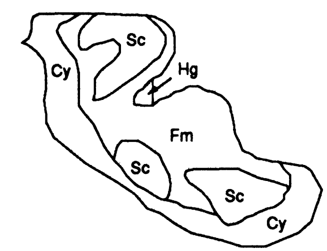
HAMILTON 20

Giltner, Ne. Quad
Sec. 21, T10N, R8W



WETLAND ATTRIBUTES

PUBFx =	2.4 acres
PEMAd =	34.2 acres
PEMCd =	11.4 acres

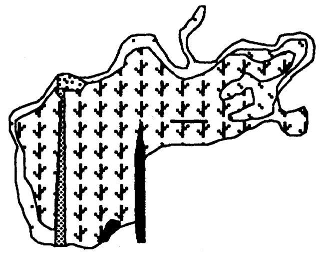


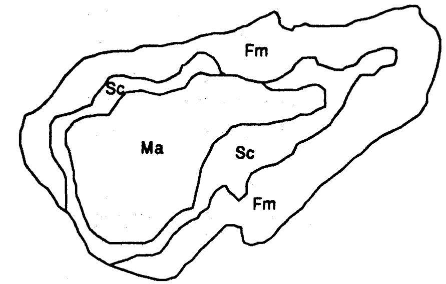
SOIL ATTRIBUTES

Fm =	36.2 acres
Sc =	25.9 acres
Cy =	24.2 acres
Hg =	1.0 acres

KEARNEY 3

Axtell E & W, Ne. Quad
Sec. 16, T6N, R16W





WETLAND ATTRIBUTES

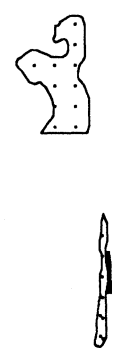
PUBFx =	4.0 acres
PEMAd =	13.2 acres
PEMCd =	5.6 acres
PEMFd =	62.8 acres
PFOAd =	0.9 acres
PSSAd =	2.4 acres

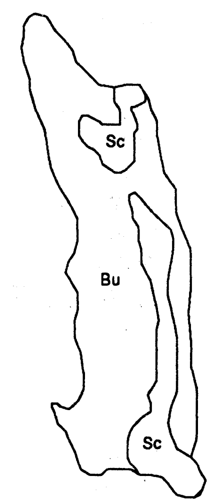
SOIL ATTRIBUTES

Fm =	85.0 acres
Sc =	38.3 acres
Ma =	56.6 acres

KEARNEY 13

Minden S, Ne. Quad
Sec. 19 & 30, T5N, R14W





WETLAND ATTRIBUTES

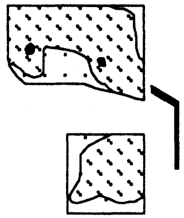
PUBFx =	0.6 acres
PEMAd =	12.7 acres
PEMCd =	2.8 acres

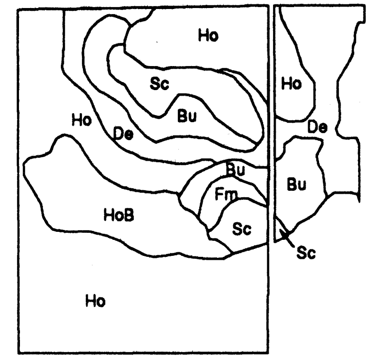
SOIL ATTRIBUTES

Bu =	87.0 acres
Sc =	28.9 acres

KEARNEY 17

Upland SE, Ne. Quad
Sec. 32 & 33, T5N, R13W





WETLAND ATTRIBUTES

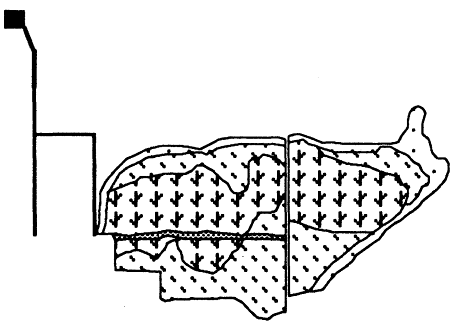
PUBFx = 1.3 acres
PEMAd = 11.8 acres
PEMCd = 30.6 acres

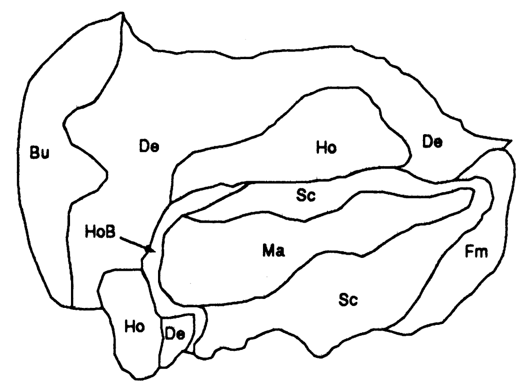
SOIL ATTRIBUTES

Bu = 28.3 acres
Fm = 4.6 acres
Sc = 21.8 acres
Ho = 127.3 acres
HoB= 28.8 acres
De = 40.0 acres

KEARNEY 20

Wilcox, Ne. Quad
Hildreth, Ne. Quad
Axtell E. & W., Ne. Quad
Sec. 27 & 28, T5N, R16W





WETLAND ATTRIBUTES

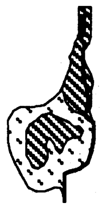
PUBFx = 1.3 acres
PEMAd = 13.2 acres
PEMCd = 41.8 acres
PEMCx = 0.5 acres
PEMFd = 50.4 acres
PSSAd = 2.3 acres

SOIL ATTRIBUTES

Bu = 38.6 acres
Fm = 19.5 acres
Sc = 56.8 acres
Ma = 44.3 acres
Ho = 46.6 acres
HoB= 9.1 acres
De = 102.4 acres

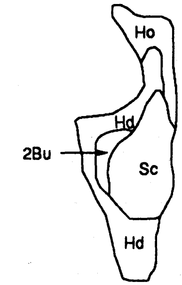
PHELPS 1

Wilcox, Ne. Quad
Sec. 36 T5N, R17W



WETLAND ATTRIBUTES

PUBFx =	1.0 acres
PUSCd =	8.8 acres
PEMCd =	10.2 acres

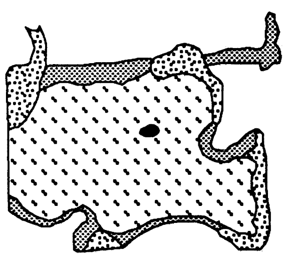


SOIL ATTRIBUTES

Sc =	15.6 acres
Ho =	7.7 acres
2Bu =	2.6 acres
Hd =	15.2 acres

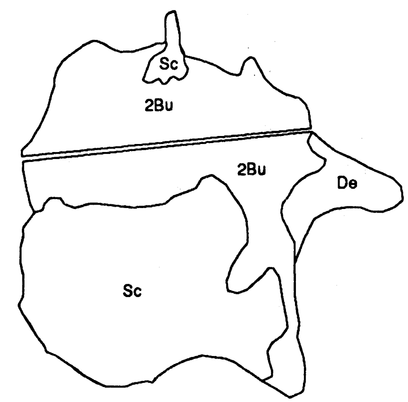
PHELPS 7

Holdrege W., Ne. Quad
Sec. 23 & 24, T5N, R19W



WETLAND ATTRIBUTES

PUBFx =	0.5 acres
PEMCd =	69.0 acres
PFOAd =	17.6 acres
PSSAd =	18.5 acres

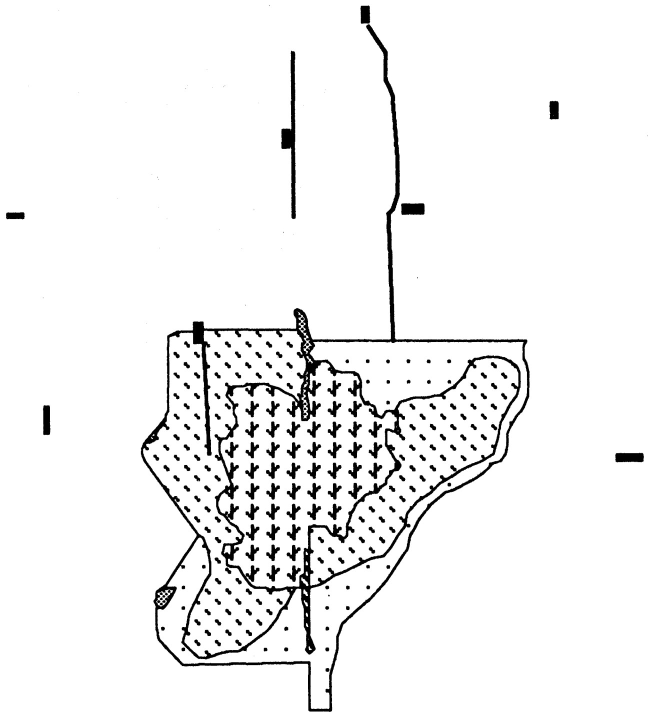


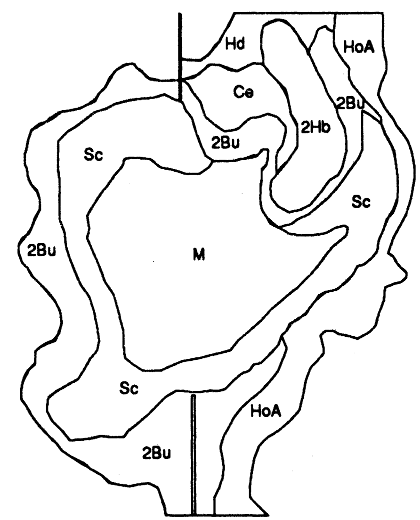
SOIL ATTRIBUTES

Sc =	101.9 acres
De =	15.2 acres
2Bu =	102.8 acres

PHELPS 21

Bertrand SE, Ne. Quad
Sec. 27 & 28, T7N, R20W





WETLAND ATTRIBUTES

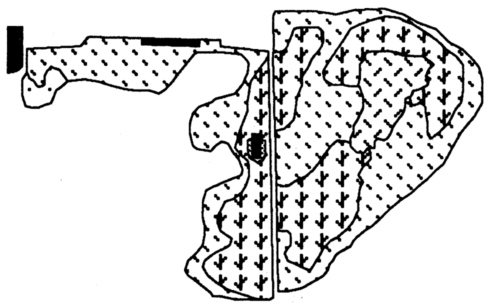
PUBFx =	4.5 acres
PUSCd =	2.1 acres
PEMAd =	60.3 acres
PEMCd =	103.6 acres
PEMCx =	0.5 acres
PEMFd =	68.0 acres
PSSAd =	3.5 acres

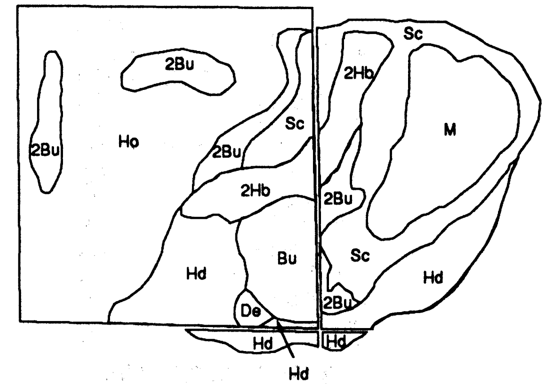
SOIL ATTRIBUTES

UP =	2.7 acres
Sc =	85.5 acres
M =	84.8 acres
Ce =	13.6 acres
HoA=	43.9 acres
2Bu=	88.4 acres
2Hb=	21.1 acres
Hd =	10.6 acres

PHELPS 24

Axtell W, Ne. Quad
Sec. 15 & 16, T6N, R17W





WETLAND ATTRIBUTES

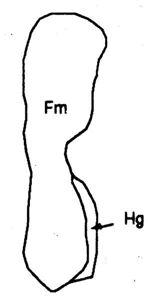
PUBFx =	3.4 acres
PEMAd =	3.1 acres
PEMCd =	78.0 acres
PEMFd =	61.0 acres
PSSAd =	1.0 acres
PABFd =	12.0 acres

SOIL ATTRIBUTES

Bu =	20.3 acres
Sc =	60.3 acres
Ho =	135.8 acres
M =	42.6 acres
De =	2.5 acres
2Bu =	36.4 acres
2Hb =	25.9 acres
Hd =	55.8 acres

POLK 18

Rising City, Ne. Quad
Shelby, Ne. Quad
Sec. 36, T14N, R1W



WETLAND ATTRIBUTES

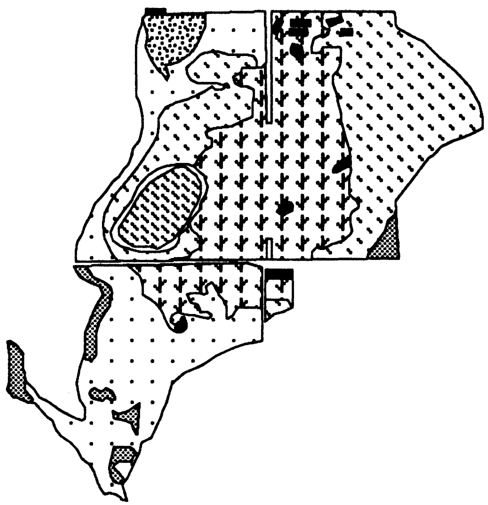
PEMCd =	10.4 acres
PEMCx =	0.1 acres

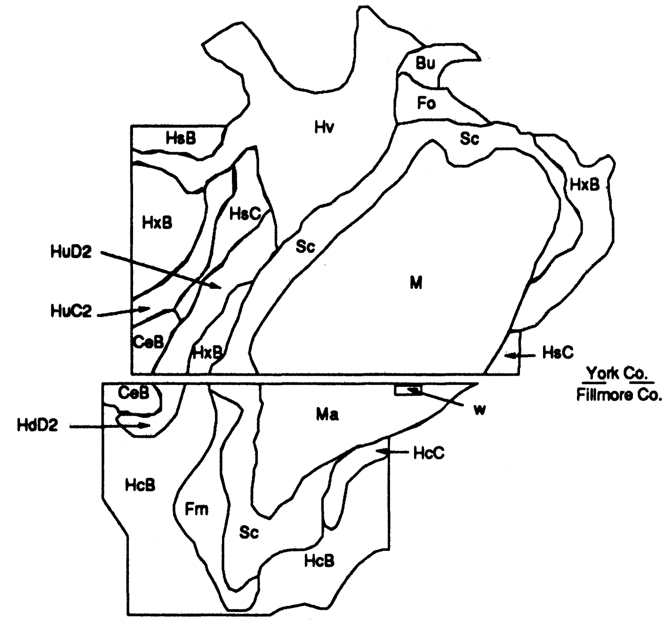
SOIL ATTRIBUTES

Fm =	32.5 acres
Hg =	2.6 acres

YORK 20

Fairmont, Ne. Quad
Sec. 33 & 34, T9N, R2W
Sec. 3 & 4, T8N, R2W





WETLAND ATTRIBUTES

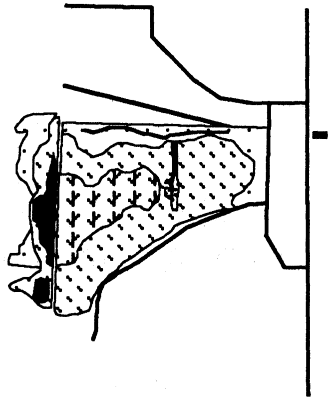
PUBFx	=	5.0 acres
PEMAd	=	44.0 acres
PEMCd	=	100.0 acres
PEMFd	=	81.7 acres
PFOAd	=	6.6 acres
U	=	3.9 acres
PEMCh	=	11.1 acres
PSSAd	=	10.6 acres

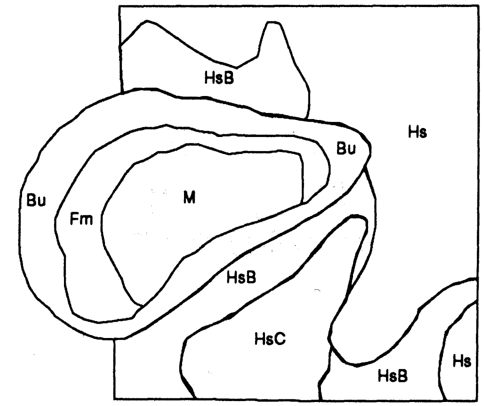
SOIL ATTRIBUTES

Bu	=	5.2 acres
Fm	=	16.4 acres
Sc	=	60.5 acres
M	=	119.6 acres
Ma	=	36.5 acres
w	=	0.8 acres
Fo	=	7.3 acres
CeB	=	9.8 acres
HsB,HcB	=	74.3 acres
HxB	=	42.7 acres
Hv	=	63.3 acres
HsC,HcC	=	18.7 acres
HuC2	=	10.1 acres
HdD2	=	17.7 acres

YORK 61

Stromsburg, Ne. Quad
Sec. 1 & 2, T12N R3W





WETLAND ATTRIBUTES

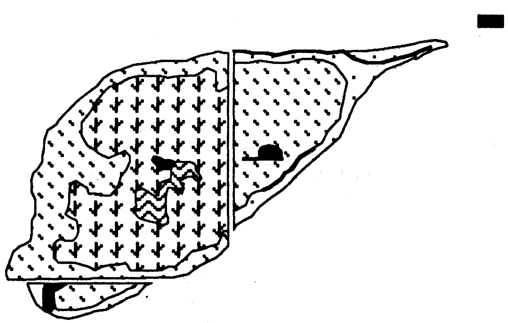
PUBFx =	5.5 acres
PEMAd =	18.3 acres
PEMCd =	40.7 acres
PEMCx =	6.3 acres
PEMFd =	14.3 acres
PFOAd =	0.8 acres
PSSAd =	0.2 acres

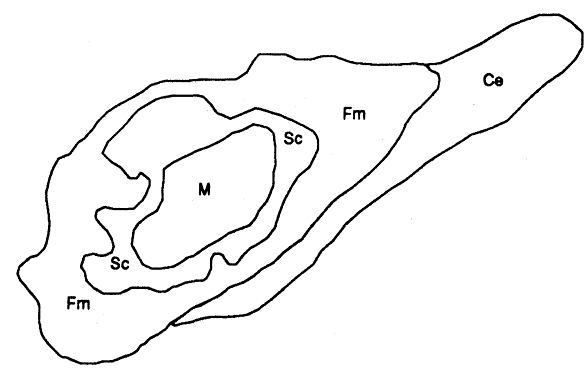
SOIL ATTRIBUTES

Bu =	59.0 acres
Fm =	34.4 acres
M =	48.3 acres
Hs =	136.8 acres
HsB =	85.4 acres
HsC =	44.8 acres

YORK 62

Durant, Ne. Quad
Sec. 10 & 11, T12N R3W





WETLAND ATTRIBUTES

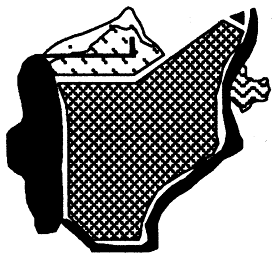
PUBFd =	4.4 acres
PUBFx =	3.3 acres
PEMAd =	15.7 acres
PEMCd =	63.7 acres
PEMCx =	1.8 acres
PEMFd =	59.7 acres

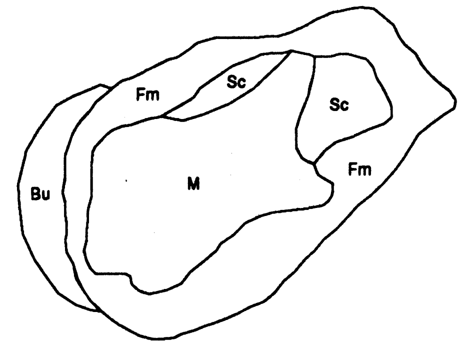
SOIL ATTRIBUTES

Fm =	106.8 acres
Sc =	44.7 acres
M =	31.3 acres
Ce =	54.2 acres

YORK 66

Durant, Ne. Quad
Sec. 18, T12N, R3W





WETLAND ATTRIBUTES

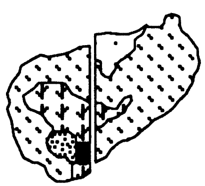
PUBFd =	3.0 acres
PUBFx =	28.7 acres
PEMAd =	4.0 acres
PEMCd =	8.7 acres
PEMCx =	0.5 acres
PUBFh =	59.0 acres

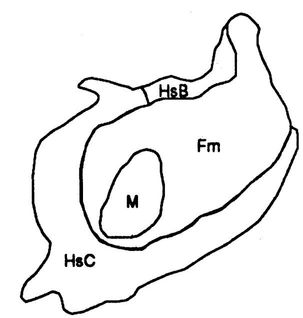
SOIL ATTRIBUTES

Bu =	21.9 acres
Fm =	100.9 acres
Sc =	25.9 acres
M =	85.3 acres

YORK 69

Durant, Ne. Quad
Sec. 9 & 10, T12N, R3W





WETLAND ATTRIBUTES

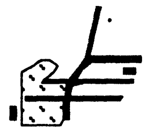
PUBFx =	0.8 acres
PEMAd =	3.6 acres
PEMCd =	32.5 acres
PEMFd =	8.1 acres
PFOAd =	2.1 acres

SOIL ATTRIBUTES

Fm =	50.1 acres
M =	10.2 acres
HsB =	5.7 acres
HsC =	49.0 acres

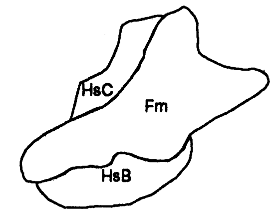
YORK 77

Utica SW, Ne. Quad
Sec. 2 & 11, T10N, R1W



WETLAND ATTRIBUTES

PUBFx =	7.0 acres
PEMCd =	5.6 acres

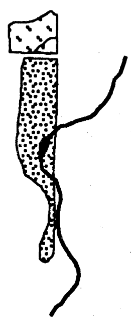


SOIL ATTRIBUTES

Fm =	41.8 acres
HsB =	14.1 acres
HsC =	8.4 acres

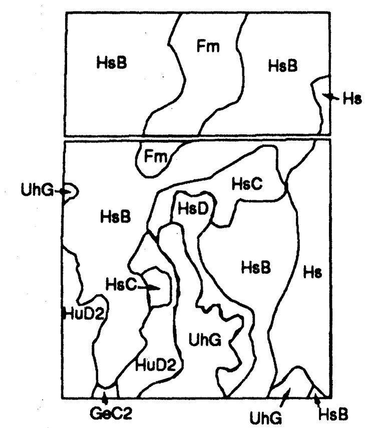
YORK 103

Utica SW, Ne. Quad
Sec. 13 & 24, T10N, R1W



WETLAND ATTRIBUTES

PUBFx =	0.4 acres
PEMCd =	4.1 acres
PEMFd =	0.8 acres
PFOAd =	13.7 acres
R4SBA =	1.3 acres



SOIL ATTRIBUTES

Fm =	23.3 acres
Hs =	28.1 acres
HsB =	134.0 acres
HsC =	14.8 acres
HsD =	10.8 acres
HuD2 =	23.2 acres
GeC2 =	0.8 acres
UhG =	21.5 acres

Appendix D. Crosstabulation results of wetland vs. soil attributes. Data presented in acres of intersection of the respective mapping units.

WET-TYPE / SOIL UNIT	U	PEMAd	PEMA	PFOA	PFOAd	PSSAd	PUSAd	PEMCd	PEMC	PEMCh	PEMCx
Bu	1877.14	88.67	5.59	0.04	0	0	0	65.63	2.51	0	3.7
2BU	153.17	28.69	0	0	5.88	7.46	0	38.26	0	0	0.01
Ce,Cy	343.05	20.83	0.37	0	0	0.12	0.23	1.14	0	0	0.24
Ct	5.01	1.93	0	0	0	0	0	0	0	0	0
CeB	343.69	6.95	0	0	0	0	0	4.31	0	0	0.01
De	280.68	4.77	0	0	0	0.95	0	2.71	0	0	4.94
Fm	1646.7	369.62	22	0.16	2.85	39.77	0	279.31	15.65	0	14.91
Fo	176.39	0.27	0	0	0	0	0	0.3	0	0	0.46
GeC2	0.81	0	0	0	0	0	0	0	0	0	0
Ha	242.2	1.51	0	0	0	0.27	0	1.63	0	0	0.46
Hc,Hs	169.7	0	0.95	0	0	0	0	0	0	0	1.3
HcB,HsB	645.99	5.75	1.04	0	3.11	2.61	0	1.12	2.07	0	0.92
HcC,HsC	127.39	2.29	0	0	4.16	1.96	0	2.75	0	0	0.19
HdC2,HuC2	281.04	2.36	10.45	0	0	0	0	1.44	3.63	0	0.06
HdD2,HuD2	37.62	2.29	0	0	1.01	0	0	0.01	0	0	0
HsD	8.86	0	0	0	1.63	0	0	0	0	0	0
He,Hv	61.96	12.97	0.09	0	6.64	0	0	4.64	0.66	0	0.55
2Hb	20.69	7.38	0	0	0	0.98	0	9.99	0	0	0.03
Hg	2.71	0.61	0	0	0	0	0	0.22	0	0	0
Ho,Hh	509.91	10.84	0	0	0	0.01	0	17.15	0	0	0
HoA,HhB	335.23	7.19	0	0	0.03	1.33	0	0.12	0	0	0
HoB	55.79	4.42	0	0	0	0.01	0	2.77	0	0	0
Hd	74.61	0	0	0	0	0	0	4.96	0	0	0
HxB	34.35	3.86	0	0	0	0.07	0	4.37	0	0	0
Int	43.54	146.51	0	0	4.61	17.33	0	93.57	0.45	0	0.93
M	24.05	5.36	0	0	2.9	1.07	0	127.52	0	9.21	0.03
Ma	36.52	46.22	2.71	0.5	4.64	4.45	0	459.12	30.88	0	0.19
Ob	24.44	0	2.39	0	0	0	0	0	0	0	0
Sc	715.76	409.16	18.89	0	16.1	40.63	0.55	659.77	31.44	1.9	6.24
Sd	33.93	7.81	0	0	0	0	0	31.2	0	0	1.93
UhG	16.79	0	0	0	3.7	0	0	0	0	0	0
w	4.57	1.93	0	0	0	0	0	3.92	0	0	0.17
Up	0	10.66	0.01	0	0.62	5.06	0	12.98	0.27	0	0.73

WET-TYPE / SOIL UNIT	PSSC	PUSCd	PEMFd	PEMF	PEMFx	PABFd	PUBFd	PUBF	PUBFh	PUBFx	R4SBA
Bu	0	0.04	13.66	0.06	0	0	0	0.01	0.13	7.78	0
2BU	0	1.54	2.29	0	0	0	0	0	0	1.56	0
Ce,Cy	0	0	0	0	0	0	0	0	0	1.97	0
Ct	0	0	0	0	0	0	0	0	0	0	0
CeB	0	0.32	0	0	0	0	0	0	0	0	0
De	0	0	0.22	0	0	0	0	0	0	0.76	0
Fm	0	6.05	20.55	0	0.68	0	3.3	0	0.52	37.58	0
Fo	0	0	0.04	0	0	0	0	0	0	3.93	0
GeC2	0	0	0	0	0	0	0	0	0	0	0
Ha	0	0	0	0	0	0	0	0	0	0.33	0
Hc,Hs	0	0	0	0	0	0	0	0	0	0.4	0
HcB,HsB	0	0	0.09	0	0	0	0	0	0	0	0.01
HcC,HsC	0	0	0.73	0	0	0	0	0	0	0	0.33
HdC2,HuC2	0	0.24	0.04	0	0.14	0	0	0	0	0.01	0
HdD2,HuD2	0	0	0	0	0	0	0	0	0	0	0
HsD	0	0	0	0	0	0	0	0	0	0.09	0.24
He,Hv	0	0	0.1	0.14	0	0	0	0	0	0.53	0
2Hb	0	0	7.59	0	0	0	0	0	0	0.29	0
Hg	0	0	0	0	0	0	0	0	0	0	0
Ho,Hh	0	0.73	0.98	0	0	0	0	0	0	3.68	0
HoA,HhB	0	0	0	0	0	0	0	0	0	0	0
HoB	0	0	0.07	0	0	0	0	0	0	1.82	0
Hd	0	1.24	0.49	0	0	0	0	0	0	0.23	0
HxB	0	0	0	0	0	0	0	0	0	0	0
Int	0	0	10.01	0	0	0	0.66	18.76	0	6.71	0
M	0	0.3	194.93	0	0	11.47	5.82	0	57.56	18.46	0
Ma	2.68	0.42	346.89	70.13	0.81	0	112.45	52.46	0	12.65	0
Ob	0	0	0	0	0	0	0	0	0	0	0
Sc	0	16.82	117.16	10.71	2.45	0.56	13.54	19.12	5.48	18.96	0
Sd	0	0	0	0	0	0	0	0	0	1.8	0
UhG	0	0	0	0	0	0	0	0	0	0.3	0.66
w	0	1.83	0.45	0	0	0	0.48	0	0	6.08	0
Up	0	0.01	1.96	0	0.59	0	0	0.01	0	4.96	0.01